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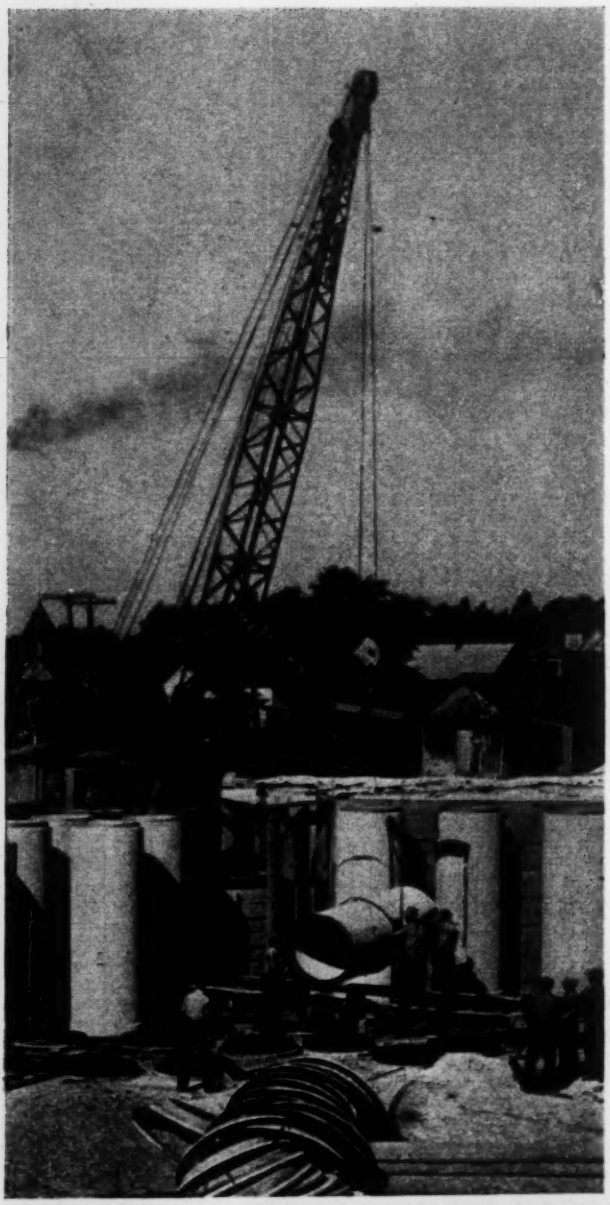
LOCK JOINT PIPE SCORES A HIT ON TO-DAY'S UNEMPLOYMENT PROBLEM



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Long Cast-Iron Main Taps New Well Field

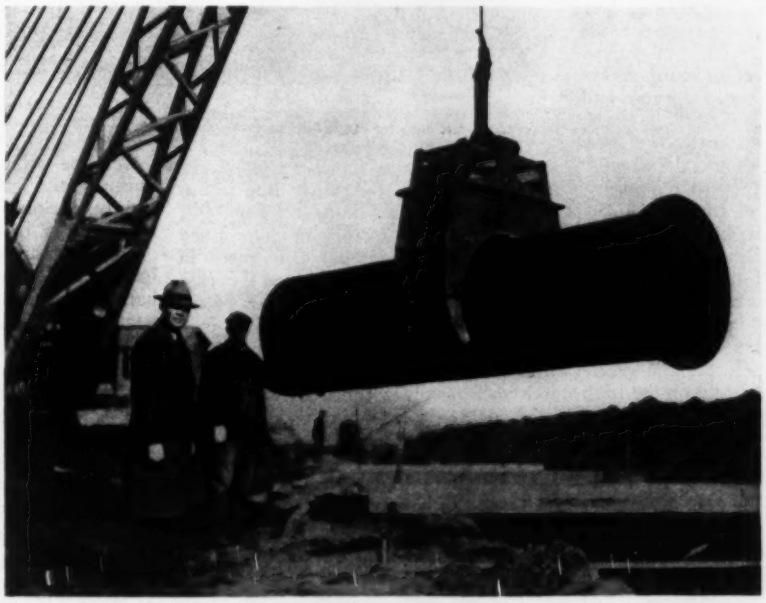
New supply for Lincoln, Neb., averts further salting of wells within the city and provides ample quantity from high-capacity wells along Platte River 25 miles away

IN THE new Ashland well-water supply system for Lincoln, Neb., recently completed in record time, are numerous points of interest. Especially to be noted are the high specific capacity of the five wells, the length of the pipe line and the central control of the individual well pumps.

Lincoln is now enjoying a new water era by reason of the fact that for almost the first time in its history it has a copious, dependable supply sufficient for the heaviest demands. In 1930 a water famine was imminent. In fact, the water went salty in all of the wells in one of the five groups from which the existing supply is obtained, showing 900 p.p.m. of chlorides against the usual 27 p.p.m. In other wells the level dropped 5 ft., whereas the average recession had been only 2 ft. per year for the preceding eighteen years. Slowly the water reservoir underground was being depleted. Out of 56 wells within the city limits 26 now give salt water. The emergency was augmented by the fear that some day excess pumping would draw salt into all of the wells. Further, Lincoln's industrial development has suffered from lack of water. One of its largest industries stopped expanding 20 years ago and developed plants elsewhere.

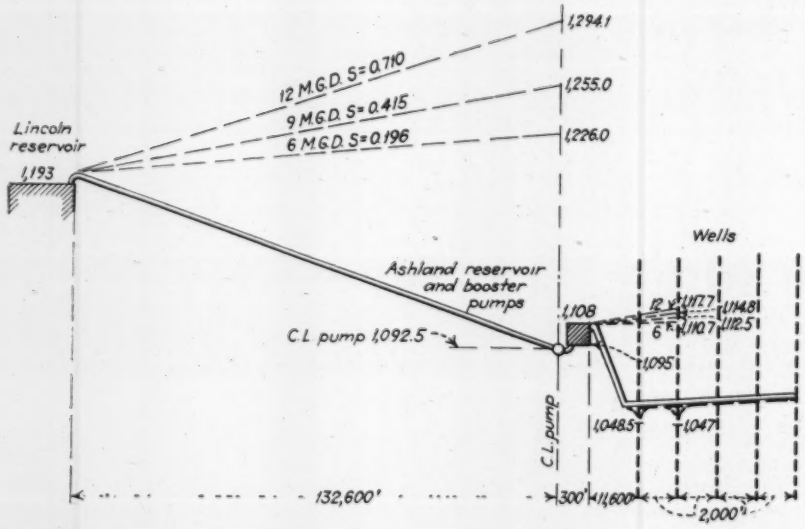
In 1923 and again in 1929 engineering reports on a new supply were made by outside consultants. Seven different sources were considered, from 11 to 48 miles away and ranging in cost from $1,000,000 to $4,500,000. In both reports the wells in the Platte River valley near Ashland, 25 miles away, were recommended, at a cost of $3,000,000. In 1930 four other sources within 6 miles of the city were investigated by the city engineer. Before a final decision was made 41 test wells were sunk, the Ashland supply proving the most satisfactory from every angle. A report by the state geologist and analysis of the quality indicated that the gravels and sands are clean, coarse - textured and will yield good water in abundance. Impervious bedrock, 80 ft. down, supports the porous materials. It draws in below Ashland to form a gorge so that the underflow coursing down the valley parallel to the live stream is brought to the surface and appears as surface flow. The river is never dry.

Special lifting tongs handling 36-in. cast-iron pipe on Lincoln's new 25-mile water-supply line.



The drillings from Ashland upstream for 6 miles showed the coarsest and best water-bearing formation to be about 3 miles northeast of Ashland. This ideal natural filter produced a clear water requiring no treatment other than chlorination in Lincoln as a factor of safety. Percolation tests showed the area to have the ability to deliver 5 m.g.d. per well.

Drawdown in the first well indicated that a 2,000-ft. spacing would avoid interference. On this spacing two wells,



Hydraulic factors in 25-mile pipe line from Ashland well field to Lincoln, Neb.

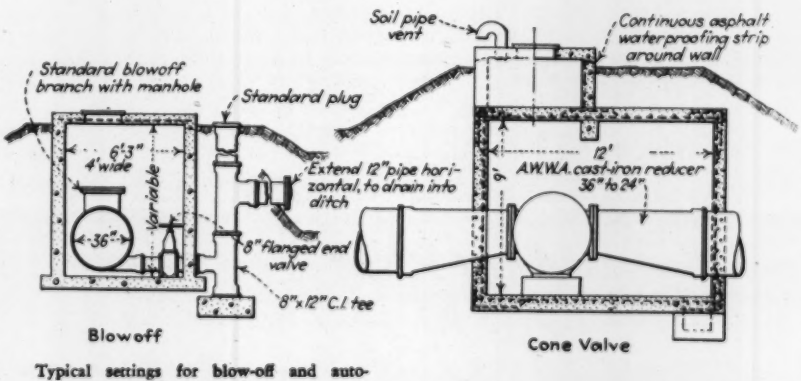
80 ft. deep and 25 in. in diameter, were installed by the Layne-Western Co. with wrought-iron well casing, and three of the same size with concrete casing were installed by the Kelly Well Co.

Each well is provided with an electrically operated deep-well turbine pump having a capacity of 1,500 gal. per minute, giving a total capacity for the five wells of 11 m.g.d. The well pumps discharge into a collection main carrying the water to a 3-m.g. reservoir and pumping station at Ashland. The static lift is about 60 ft. from drawdown level to reservoir, with friction adding 2 to 9 ft. more depending on the pumping rate. The reservoir in Lincoln is 25.3 miles away and 100 ft. higher than the pumps at Ashland. Drafts of 6 and 12 m.g.d. add 33 and 101 ft. additional, respectively, for friction head.

Normally the water level in the wells is within 2 ft. of the surface, so it was deemed economical to locate the reservoir out of the wet area and on the high ground behind the booster pumping station.

A complement of 6-, 9- and 12-m.g.d. motor-driven centrifugal pumps housed in a brick and stone pumping station gives flexibility at economical rates for each unit. There is a capacity of 30 m.g. in the Lincoln reservoir and a safe capacity of 4 m.g.d. still available from the wells in Lincoln.

Fortunately, the route of the pipe line could be made parallel to the paved state highway and to the tracks of the Chicago Burlington & Quincy Railroad all the way into town on the right-of-way of one or the other. This location greatly reduced right-of-way expense, delay and litigation. The route is ideal, in that the whole line can be inspected in an hour's time, delivery of material was greatly facilitated and hauling of pipe reduced to a maximum of 4 miles. The grade is comparatively flat and the maximum cut on the whole line is but 16 ft.



Typical settings for blow-off and automatic cone valves.

A pipe size of 36 in. was determined by balancing the annual differences in pumping costs on the estimated increase in consumption against the fixed charges on the pipe-line cost. Cast-iron pipe was chosen by the water board after bids were taken on cast iron, steel and concrete pipe. (See *ENR*, June 9, 1932, p. 844 for tabulation.) Instructions to bidders provided that the city would give consideration to such difference as, in its opinion, existed between the different materials in durability, first cost, maintenance, liability to breakage and hydraulic efficiency affecting pumping costs.

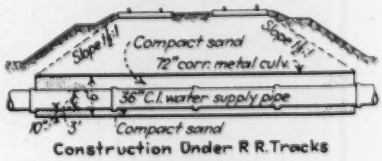
Structural computations were made on various thicknesses of cast iron pipe which indicated that for the backfill loads and pressures to be encountered a minimum thickness of 1.07 in. would be required. In drafting the specifications the decision was made to call for standard sand-cast pipe but to name three classes in accordance with the varying pressures. The 150 class for 150-ft. head is 1.07 in. thick, intermediate between A.W.W.A. class A and B; 200 class for 200-ft.; class B, 1.15 in. thick; and 250 class for 250 ft. is intermediate between A.W.W.A. class B and C, 1.26 in. thick.

Other specifications included the following: Joints are made with 99 per cent lead and clean dry braided hemp or jute free of tar or oil. In laying the pipe, two blocks were used, one behind the hub and the other 2 ft. from the spigot end. The blocks were set in slots in the bottom of the trench on undisturbed earth, projecting ¾ in. above the trench bottom. Calking was done by compressed air.

Laying was specified in detail. Before the spigot of the pipe being laid was entered into the bell of the preceding pipe, the first strand of yarn was held in place on the spigot end by the yarner, so as to center it in the bell. If, when the derrick was slacked off, the joint space at the bottom was found to be smaller than at the top, the pipe was again raised and additional yarn was driven into the lower part of the bell. When the joint space had been made uniform, the gasket was completed by tightly packing yarn into the bell to within 2½ in. of the face.

In order to obtain full bearing the backfill under and around the pipe was hand or mechanically tamped or compacted by flooding. As many tampers as backfillers were required in all

Under railroad tracks a 72-in. corrugated metal pipe was jacked as a housing for the cast-iron pipe, which was packed in with compacted sand.



Construction Under R.R. Tracks

Modern building of brick and stone at Ashland houses the pumps for Lincoln's new well-water supply.

trenches. All pipe was laid in open cut, the maximum depth being 16 ft. No stones, cinders, frozen earth or rubbish was permitted in the backfill. Inside the city limits and under crossings all backfilled trenches were flooded.

Well collector main was laid in a sand box in a trench excavated by dragline after drying out by closely spaced well-point system. The natural groundwater level was within 2 ft. of surface.

Under railroad tracks the pipe was to be laid in a timber-lined tunnel and reinforced with concrete deposited through temporary vertical pipes from the tunnel roof to the surface, but the same type of construction was finally used as under highways. This method consisted of jacking a 72-in., 10-gage, corrugated metal culvert beneath the tracks or roadway. The pipe was then laid in the culvert, and the space outside of the pipe was packed with sand. The ends of the culvert were bricked up. At one spur track the railroad removed the tracks and relaid them after the pipe trench had been backfilled.

Maximum leakage permitted by the specifications was 100 gal. per day per inch diameter per mile of pipe when subjected to a hydrostatic head corresponding to a pressure gradient 50 ft. above and parallel to the calculated hydraulic gradient when pumping at the rate of 12 m.g.d. The pipe line everywhere is below the hydraulic gradient.

Actual leakage in test after the completion of the whole line was 7.01 gal. per minute. The results of the tests on the separate sections are as shown in the following compilation:

Sec.	Length, Ft.	Leakage, g.p.m.	Leakage, Gal. Per Inch Diameter Per Mile Per 24 Hours
A	51,200	2.46	10.16
B	29,700	2.24	15.95
C	31,600	0.90	6.02
D	20,100	1.41	14.83
Total	132,600	7.01	11.18

A 2-year guarantee is called for, at the end of which another test will be made.

To limit any undue increase of pressure in portions of the pipe due to surge or water hammer, four 24-in. automatic cone valves were installed. They can also be operated manually as stop valves. At all summits there are 2-in. air valves of the automatic cluster type. Twenty-seven 8-in. blowoffs are provided at low points, discharging through 12-in. risers into creeks. The risers are closed with plugs and the horizontal portion with blank flanges. To cut friction losses and eliminate anchorages, both horizontal and vertical curves were made with double-bell pipe cut in half on a 2 deg. 12 min. angle with which 145-ft.-radius curves were possible.

Construction of the collector line between the wells was carried out in trenches in which water normally stood within 2 ft. of the original surface. Well points were used on one or both sides of the trench to hold down the water level. Points were spaced 18 in. apart and discharged into a suction header 200 ft. long laid on each side of the trench to two pumps having capacities of 1,500 gal. per minute each. Each pipe was laid and calked in a sand box.

Tests on the wells indicated specific capacities as tabulated on p. 490.

Two of the motor-driven centrifugal units in the tile-lined Ashland pumping station. The central-walk bridge may be removed by the traveling crane. The pumps are protected by cone check valves on the discharge side and can be isolated by manually operated gate valves on both suction and discharge.

SPECIFIC CAPACITIES OF WELLS TESTED

Well No.	Contractor	Depth, Ft.	Water Table Below Surface, Ft.	Quantity Pumped at Test, g.p.m.	Net Drawdown, Ft.	Specific Capacity, g.p.m. Per Ft.
1	Kelly Well Co.	86	2.5	2,700	14.6	185
2	Layne-Western Co.	86	6.0	2,400	16.5	146
3	Layne-Western Co.	62	6.0	2,400	19.4	124
4	Kelly Well Co.	46.5	4.5	2,370	20.9	113
5	Kelly Well Co.	66.5	3.0	2,450	18.0	136

The deep-well turbine pumps are remotely controlled from the main pumping station at Ashland by means of telephone-type automatic supervisory-control equipment, which permits starting and stopping and checking the operation of each well from the station. The audible indicating equipment is set in operation by dialing an automatic telephone apparatus. This indicates by variously pitched buzzes whether the pump is in operation or not. Only two copper wires are used to connect the dispatching equipment of the main pumping station with the five wells. With the addition of a standard portable telephone set, this system is used as a means of communication between the main pumping station and the individual wells during maintenance operations.

Location borings were started in January, 1931. Bonds for the work were voted April 7, 1931. Contract was let Sept. 29, 1931, and the last piece of pipe was laid on July 16, 1932, completing the project within one and a half years after the detail investigation work started.

The total cost of the project was $1,800,000, of which $1,309,000 was for the main pipe line, $211,000 for the well-collection main and $280,000 for land, wells, reservoir, pumping station, pumps, connections to existing reservoirs and engineering costs.

The preliminary reports on the Lincoln supply were made by Burns and McDonnell, consulting engineers, Kansas City. All subsequent engineering work has been handled by the city engineer, D. L. Erickson, and his office staff. The general contractor, who had eleven cranes and five draglines on the pipe-line work was Abel and Dobson, Lincoln. For the reservoir and pumping station at Ashland, Arthur A. Dobson was contractor. Dobson and Humphreys, Lincoln, had the contract for the well-collection main.

Modern Filter Plant in China Built by Coolie Labor

Lingnan University builds 1-m.g.d. water-purification plant on which all construction work was done by hand labor—Elevated steel tank erected using bamboo scaffolding

By Ellwood H. Aldrich
Sanitary Engineer, New York, N. Y.

TO PROVIDE an adequate supply of pure water, Lingnan University, an important educational center of south China, has recently placed in operation a modern filtration plant. While the size of the plant is small, the treatment afforded and the equipment provided are unusually complete, and it embodies modern methods of water treatment as typified in recent works of similar character constructed in the United States.

Lingnan University, formerly known as Canton Christian College, embraces a community of about 2,000 and is located on the Pearl River 3 miles below Canton. Provision has been made in the design of the plant to allow for the normal growth and expansion of the community for many years. The location of the water plant below the city and suburbs of Canton with a population of nearly 1,000,000, including a large floating population living in sampans and junks, has resulted in the necessity for treating a highly polluted water. Aside from the usual turbidity of the river, the sewage, refuse and organic wastes resulting from the proximity to the city have made complete and thorough treatment obligatory.

The treatment plant is of the gravity, rapid-sand-filtration type with a capacity of 1,000,000 gal. daily. The raw-water supply is secured directly from the Pearl River through a trash rack and sluiceway opening into a raw-water settling basin. The level of the river at this point, about 90 miles above its mouth, is affected by the tides and has a normal variation of 6 to 8 ft. By means of a tide gate the raw-water settling basin is filled automatically twice a day at high tide. With a capacity of more than 1 m.g., the retention provided in the basin allows the heavier grit and sediment to settle out as the first step of the treatment process.

From the settling basin the raw water flows by gravity to a screen chamber and suction pit for the low-lift pumps. A coarse bar screen with a clear bar spacing of 1 in. is provided, followed by a fine brass screen with a ½-in. opening. Two 0.5-m.g.d. motor-driven centrifugal units pump the water through a spray system into a basin with a capacity of 200,000 gal. This is located at a sufficient elevation to allow gravity flow through the following treatment stages and has sufficient capacity to allow some independence from tide conditions. Aeration is secured through a system of spray nozzles. Aeration was considered necessary because of the high organic content and the considerable amounts of iron and hydrogen sulphide in the water.

From the aerator basin the water flows to a mixing basin where it is treated with alum, lime or other chemical fed by dry-feed chemical machines. After a detention of 15 min., accompanied by mechanical agitation, the mixed water passes to the coagulating basin having a detention of about four hours under maximum conditions.

There are three rapid-sand filters located in the filter house. The filter beds are supported upon a system of cast-iron underdrains and consist of 18 in. of graded gravel and 30 in. of filter sand secured locally. Beneath them is the filtered-water basin. The filter units are completely equipped with the necessary operating valves and loss-of-head and rate-of-flow gages.

Final sterilization of the filtered water is secured by treating it with liquid chlorine as it passes to the filtered-water basin. Provision has also been made for pre-chlorination if such should be found desirable.

From the filtered-water basin the water is pumped by two 0.5-m.g.d. motor-driven centrifugal units into an elevated tank of 30,000-gal. capacity, 125 ft. high, located above the filter house; or to the distribution system as the necessity requires.

In so far as practicable, the operation of the plant is automatic. One low-lift pumping unit is automatically controlled by float valve actuated by the elevation of the water in the aerator basin. Similarly, one of the high-lift units is so controlled from the elevated tank. All pumps are primed with water jet exhausters, and those of the automatic units are controlled through solenoid-operated valves that operate with the motor starters.

A float valve is located in the aerated water line and operates to keep the level of the water in the coagulating basin—and therefore on the filters—at the desired elevation. The filters operate continuously to keep the filtered-water basin full and are automatically shut off at the high level by a high-level shut-off arrangement attached to the controllers. Consequently the filtration plant will operate automatically with little attention save to take proper care of the filters and equipment and to make adjustments in the chemical and chlorine doses.

Complete laboratory equipment is

provided for making all chemical and bacteriological tests, and a close check will be kept upon the purity of the water.

In conjunction with the filter plant and located in the filter house two diesel-engine-driven generators of 55-kva. capacity each have been installed to furnish light and power for the plant and for the university community. The units are complete with air compressor starting unit, oil clarifier, fuel-oil pump and tank, and the usual engine accessories.

A complete and modern switchboard installation is included to control the various services. Generation is at three phase, 60 cycle and 240 volts. The service to the campus and community is stepped up through tranformers to 2,400 volts; and high-tension lines, transformer equipment and accessories have been installed to connect up with the existing low-tension lines. The generating plant and equipment is no less complete and modern than the filtration plant, to insure dependable and economical operation.

Because of the location of the plant upon an important part of the campus, particular attention was directed to the appearance of the buildings and equipment and to the architectural appearance of the whole. In connection with the intake structures, a new canal and sampan harbor were constructed west of the esplanade, and the old canal was utilized for the raw-water basin. The development of the esplanade by grading and the construction of walks and the future construction of a gate house for entrance to the university will improve the utility and appearance of the river entrance to the campus.

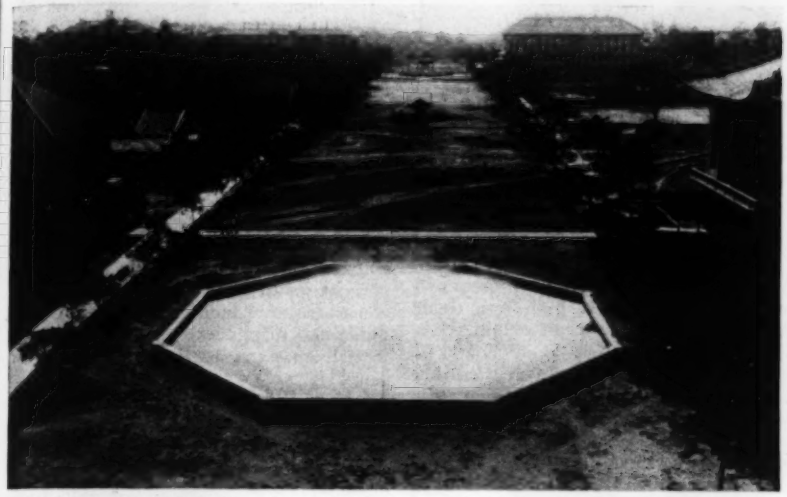


Fig. 1—Aerator basin is located in the esplanade of the university grounds. There are 25 spray nozzles operating under 5-lb. pressure. Water flows by gravity from the aerator to the coagulation basin.

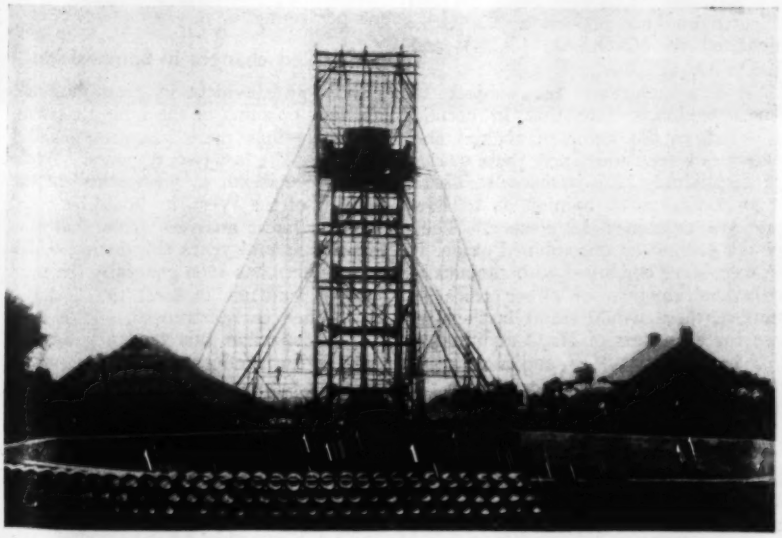


Fig. 2—The steel tower and tank were erected by coolie labor, which built a scaffolding consisting of wood poles and bamboo. Scaffold members were lashed together with bamboo ties. The scaffold withstood wind velocities of more than 75 miles per hour.

The majority of the equipment for the plant was secured from the United States. All the work was done by hand labor under contract. The erection of the structural-steel tower and tank presented some difficulties until simplified by the erection of bamboo scaffolding in Cantonese style.

The scaffolding consisted of 4- to 6-in. poles and bamboos, tied together at the joints with split bamboos. No nails or other ties were used. The bamboo ties had to be replaced about once a month during the dry season, but the members were used many times. Although the coolies erecting the scaffolding had no theoretical knowledge of stresses, when at full height it withstood several small typhoons with wind velocities of 75 to 80 miles per hour. The cost of the structural-steel erection was about $350, of which $190 was the cost of building the scaffold.

Further analysis of the cost of the work reveals some interesting facts of the cost of labor and materials in China. Exclusive of engineering costs, the following figures represent the cost of the plant.

Excavation and disposal	$2,400
Substructure, including erection of structural steel, machinery and equipment	52,000
Superstructure (estimated)	4,800
Electrical service lines	3,800
Water service lines	2,000
Total	$65,000

Of this amount the equipment, machinery, cast-iron piping and structural steel purchased in the United States amounted to about $45,000. Some sample costs of materials secured in China and the prevailing wages expressed in gold dollars may be of interest.

Excavation and disposal, per 100 cu.ft.	$0.50
Concrete per cu.yd., 1:2:4 in place	6.00
Steel reinforcement in place, per lb.	0.02
12-in. vitrified tile in place, per ft.	0.26
18-in. concrete pipe in place, per ft.	0.86
Cement, per bbl.	2.20
Sand, per cu.yd.	0.40
Crushed stone, per cu.yd.	1.60
Form lumber, 1 in., per sq.ft.	0.02
Structural-steel workers, per day	0.50
Carpenters	0.40
Plumbers	0.40
Masons	0.30
Blacksmiths	0.30
Common (coolie)	0.15-0.30

The Yui Tai Construction Co., of Canton, performed the grading and excavation, substructure work and the installation of machinery and equipment. S. C. Young, of Canton, was associated with the project as architect for the filter building. The design of the plant and supervision of its construction was carried out by the writer.

The trustees of the university, under a committee headed by W. Henry Grant, and under whom the work was authorized with the cooperation of the university authorities, are to be commended for providing a sanitary water supply that promises to be of great value, not alone to the community but more as an example to a section of the country where the importance of sanitation is not as yet fully realized.

Portland Cement Today and Twenty Years Ago

Comparison of analyses of 1909-1918 with those of 1932 shows the older cements to be generally lower in tricalcium silicate, with some noteworthy exceptions

By P. H. Bates

Chief, Clay and Silicate Products Division, Bureau of Standards, Washington, D. C.

THIS article has been suggested by numerous statements which imply that in recent years the composition of portland cement has been materially changed. Analysis and calculations presented here verify this belief.

The change originated in a desire on the part of users for a product having higher strengths at early ages, a need which it seemed could be most readily met by changes in composition. Individual producers, responding to this demand, instituted rather an interesting race to see how much the strength of their cement could exceed that of their competitors and that of their own output of a few years before. As is so frequently the case, the pendulum is now moving in the other direction; there seems to be a growing belief on the part of some users that factors other than early strength are of paramount interest.

The query arises whether or not the "old-time" cement was decidedly different from (and better than) the cement now on the market. Rather peculiarly, the discussion seems to center about the silicate composition of the cement, apparently on the assumption that this composition is the dominating influence in the department of cement.

Old-time and recent compositions

Without any regard to the validity of the assumption, there are presented in the accompanying table the partial analyses of a number of cements made from 15 to 23 years ago, and analyses of the products of the same plants within the past year or two. There are also tabulated the calculated percentages of tricalcium silicate, dicalcium silicate, tricalcium aluminate and calcium ferro-aluminate, determined from the oxide analyses on several assumptions discussed below.

Where the numeral designating the cement is followed by the letter W, the analysis was made at the San Francisco branch of the Bureau of Standards, and the cements were made in Colorado or other Western states. Similarly, the letter E indicates Eastern cements, from mills mostly in the Atlantic Coast states (a few are in the Mississippi Valley), the analyses of which were made in the former structural-materials testing laboratory of the Technologic Branch of the U. S. Geological Survey; that laboratory and its work were transferred to the Bureau of Standards in 1910. The analyses of the recent cements were furnished by the manufacturers.

The last six lines of the table also give the analyses (made in the structural-materials testing laboratory) of a few old cements that are of interest owing to their relatively high iron oxide content or their European origin. Except in case of Nos. 39 E, 40 E and 41 E, the plants which produced these are no longer operating. The last two were of German origin. One was known as an Erz-Zement (iron-ore cement); the other was the then well-known Dyckerhoff brand, which had been used both in the foundation of the Statue of Liberty in New York Harbor, and in the lower portion of the Washington Monument in Washington, D. C.

Calculating the compounds

In calculating the percentages of the compounds present in the cement, it is assumed that all the Fe_2O_3 is present as $4CaO.Al_2O_3.Fe_2O_3$ (referred to here as 4C.A.F.) unless there is not enough Al_2O_3 to satisfy the iron oxide. In such a case the alumina is all calculated to this compound, and the excess iron oxide to $2CaO.Fe_2O_3$. (2C.F), which is not given in any case in the table. The Al_2O_3 remaining from the first calculation is regarded as combined as $3CaO.Al_2O_3$ (3C.A.). All the lime not in combination with the Al_2O_3 and Fe_2O_3 as just indicated and not present as CaSO is calculated to $3CaO.SiO_2$ (3C.S) and $2CaO.SiO_2$ (2C.S).

These assumptions are subject to some question. Note that in certain cases, where the oxide of sodium and potassium were determined, these oxides are surprisingly high in amount. There is no consensus of opinion as to how they are combined in cement. They are not present as uncombined oxide. If the soda were combined with chemically equivalent amounts of either silica or alumina, there would result in the first case for each part of Na_2O an increase of 7 parts in the 3C.S and a decrease of almost the equivalent per cent in the 2C.S; and in the second case a decrease of 4 parts in the 3C.A.

Carbon dioxide is invariably present in cement, very likely as calcium carbonate. The analyses show in some cases more than 1 per cent. There are a number of ways in which this lime could have been combined before calcination. If it were combined with SiO_2, then each part of CO_2 has reduced the 3C.S by approximately 5 parts and increased the 2C.S by about 4 parts.

Uncombined lime, also usually present in cement, is not considered here. Practically all cement contains adsorbed or added water; this has caused the breaking down of certain compounds and the formation of hydrated lime, which in the commonly used ammonium acetate method for determining uncombined lime would appear as hydrated lime and not free lime. But one part of uncombined lime will reduce the calculated 3C.S by about 4 parts and increase the 2C.S by about 3 parts.

Other oxides also are present in amounts that may materially change the percentage of the assumed four major constituents. Among these are titanium oxide and manganese oxide, which may total from a few tenths to nearly 1 per cent.

Another large factor to be considered in the accuracy of such calculations is the accuracy of the chemical analyses. If a plus error of but 0.1 per cent in each of the silica, alumina, and iron oxide were made, the 3C.S would be decreased 1.5 per cent and the 2C.S increased slightly less. A minus error of 0.1 per cent in SiO_2 and a plus error of the same amount in CaO will increase the 3C.S by slightly more than 1 per cent and decrease the 2C.S by slightly less.

The calculated compositions are presented here only to the nearest whole per cent in the case of the silicates and nearest half per cent in the case of the alumina and iron compound. In those columns where the difference between the calculated constituents of the early cements and the later cements is given, no difference is indicated in the case of the silicates unless it exceeded 3 per cent nor in the case of the iron and alumina compound unless it exceeded one per cent.

Marked changes in composition

It is quite evident in examining the last four columns of the table that with few exceptions there has been marked change in the last twenty years. While the change is not so pronounced in the cements of the West. it should be noted that the latest analyses from that section are several years old, during which period there has been generally the most marked tendency to meet the demands for higher early strength. It is also rather clear that this tendency has led most of the producers to make cements of more similar composition now than earlier.

The changes are those which research has shown would produce greater early strength. It would seem that the producers have been most apt and prompt in applying research results.

But whether the later cements are better or poorer so far as serviceability is concerned is a matter for the future to determine. It is even rather early to judge the "permanency" of concrete made from the cements of twenty years ago.

It should be specially noted that the early cements were not all of low tricalcium silicate contents. Indeed, 11 out of 23 of the Eastern cements contained 35 per cent or more 3C.S. Such a value indicates that this compound was present in an amount equal to or greater than the dicalcium silicate. The cement upon which the Statue of Liberty stands contains by calculation 10 per cent more 3C.S than 2C.S and an alumina content one-sixth more than the 6 per cent so frequently indicated as the upper limit for cement used in contact with sea water.

If the analyses and the constitutents of the cements at the two ages are compared, it will be noted that, even where the changes in the composition have been marked, the difference in the percentages of oxides found by the analyses is not nearly as pronounced. The reason for this has already been stated. Attention was called to the fact that a minus error of 0.1 per cent in silica and a plus error of the same amount in the lime content would increase the per cent of 3C.S slightly more than one per cent and decrease the 2C.S by a slightly lesser amount. It follows, of course, that if a manufacturer has actually made changes in his raw mix that would result in changes of this magnitude in the analysis of his finished cement, he would have made equivalent changes in the composition of his product. Decreasing the silica content by 0.5 per cent and increasing the lime by 0.5 per cent will increase the 3C.S by approximately 5 per cent.

Changes of such small magnitude in oxide content would hardly be noticed unless pains were taken to calculate the components present. This latter is seldom done. Too frequently it has been assumed that small oxide variations have no significance, whereas calculations show the opposite. It will not suffice to compare the analyses expressed only as oxides; in order to realize differences, it is essential to make comparisons on the basis of the calculated amounts of constituents. Few realize the extent to which the slight changes made over a period of years have affected the chemical and physical nature of the finished product.

Again, it may be well to caution those inclined to use the composition

ANALYSIS AND CONSTITUTION OF FORMER- AND PRESENT-DAY PORTLAND CEMENTS

No.	Date	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Loss	Na_2O	K_2O	CO_2	3C.S	2C.S	3C.A	4C.A.F	A*	B*	C*	D*
1W	1918	21.9	5.5	2.1	62.5	3.2	1.4	2.7				44	30	11.0	6.5				
	1930	20.6	7.0	2.0	63.6	3.4	1.8	1.3				47	24	15.0	6.0	0	— 6	+4.0	0.0
2W	1918	21.9	7.0	2.5	62.9	1.4	1.7	2.1				35	36	14.5	7.5				
	1930	21.4	8.0	2.2	64.1	1.6	1.5	1.0				37	34	17.5	6.5	0	0	+3.0	0.0
3W	1914	22.4	5.8	2.7	61.1	3.7	1.3	2.6				32	40	11.0	8.0				
	1930	20.8	6.8	2.0	63.3	3.8	1.6	1.5				46	25	14.5	6.0	+14	—15	+3.5	—2.0
4W	1918	20.8	7.4	2.4	64.2	1.9	1.5	1.3				46	24	15.5	7.5	0	0	0.0	0.0
	1930	20.6	7.8	2.4	64.2	1.9	1.6	1.2				45	25	16.5	7.5				
5W	1918	208	6.2	2.9	63.6	1.9	1.6	2.5				51	21	11.5	9.0				
	1930	21.5	6.6	2.7	63.8	2.4	1.7	1.1				43	30	13.0	8.0	— 8	+ 9	+1.5	0.0
6W	1918	20.5	6.4	3.2	62.4	2.6	1.4	3.0				46	24	11.5	9.5				
	1928	21.2	6.4	2.3	64.2	2.2	1.5	1.9				50	22	13.0	7.0	+ 4	0	+1.5	—2.5
7W	1914	22.1	7.5	2.4	63.6	1.2	1.5	1.0				33	39	16.0	7.5				
	1930	21.0	7.8	2.9	65.0	1.0	1.5	0.6				45	26	16.0	9.0	+12	—13	0.0	+1.5
8W	1914	22.6	5.9	3.3	61.7	1.9	1.7	2.3				30	41	10.0	10.0				
	1930	21.1	6.8	2.9	63.3	1.8	2.0	1.8				42	29	13.0	9.0	+12	—12	+3.0	0.0
9W	1914	23.3	6.1	2.2	63.5	1.5	1.4	1.5				33	42	12.5	6.5				
	1929	22.5	6.1	2.5	64.3	1.3	1.7	1.7				41	34	12.0	7.5	+ 8	— 8	0.0	0.0
10W	1914	22.5	6.3	2.2	62.3	3.4	1.6	1.4				33	40	13.0	6.5				
	1930	20.9	7.7	2.2	62.1	3.9	1.7	1.5				34	35	16.5	6.5	0	— 5	+3.5	0.0
11W	1918	21.4	6.4	3.0	63.1	1.3	1.5	2.5				43	29	12.0	9.0				
	1930	22.2	7.1	2.4	64.1	1.7	1.4	1.0				37	36	15.0	7.5	— 6	+ 7	+3.0	—1.5
12W	1914	19.9	7.0	2.7	62.6	3.7	1.5	1.9				48	21	14.0	8.0				
	1930	22.6	6.4	2.4	61.6	2.9	1.9	1.9				27	45	13.0	7.5	—21	+24	0.0	0.0
13E	1911	22.3	6.6	2.3	63.8	2.4	1.1	0.5	.21	.32	.66	40	33	13.5	7.0				
	1932	22.8	6.2	2.3	62.4	2.7	1.4	1.6				32	41	12.5	7.0	— 8	+ 8	0.0	0.0
14E	1909	20.3	7.6	2.6	62.9	2.8	1.7	1.0	.30	.68	.30	42	27	15.5	8.0				
	1932	21.4	5.3	4.2	64.1	1.5	1.9	1.1				51	23	7.0	13.0	+ 9	— 4	—8.5	+5.0
15E	1909	21.4	6.8	3.7	63.4	1.6	1.4	0.8	.09	.31	.78	40	31	12.0	11.5				
	1932	20.6	5.3	3.6	64.5		1.8					60	14	8.0	11.0	+20	—17	—4.0	0.0
16E	1909	20.5	8.2	2.7	62.4	3.1	1.6	1.1	.16	.54	.15	35	32	17.0	8.0				
	1932	19.9	7.5	2.5	63.2	2.9	1.8	1.0				47	22	15.5	7.5	+12	—10	—1.5	0.0
17E	1909	20.8	7.8	2.4	60.5	3.3	1.8	1.7	.16	.80	1.11	27	39	16.5	7.5				
	1932	20.5	7.0	2.4	63.4	3.2	1.9	0.9				47	23	14.5	7.5	+20	—16	—2.0	0.0
18E	1909	20.3	7.6	2.6	62.3	2.8	1.5	1.0	.41	.75	1.08	41	27	15.5	8.0				
	1932	20.2	7.5	2.4	62.8	3.2	1.8	1.1				43	26	15.5	7.5	0	0	0.0	0.0
19E	1909	19.8	7.6	2.1	62.4	3.9	1.4	1.8	.24	.26	.92	45	22	16.5	6.5				
	1932	19.7	6.7	3.1	63.8	3.0	1.7	1.5				56	14	12.5	9.5	+11	— 8	—4.0	+3.0
20E	1909	22.0	7.3	2.6	61.6	3.1	1.5	0.6	.40	.32	.86	27	42	15.0	8.0				
	1932	20.2	7.7	2.5	62.8	2.6	1.8	1.4				42	26	16.0	7.5	+15	—16	0.0	0.0
21E	1909	21.3	6.3	2.8	62.3	3.5	1.5	1.7	.16	.28	.52	41	30	12.0	8.5				
	1932	21.1	6.6	2.4	63.3	N.D.	1.6					45	27	13.5	7.5	+ 4	0	+1.5	0.0
22E	1908	24.0	3.8	6.1	61.9	0.7	1.5	0.8	.68	.44	.37	31	45	0.0	18.0				
	1932	22.1	5.0	3.7	65.2	N.D.	1.9					52	24	7.0	11.5	+21	—21	+7.0	—6.5
23E	1910	22.3	7.1	3.2	62.9	1.8	1.4	0.8				31	41	13.0	9.5				0.6
	1932	19.9	7.2	3.5	63.6	2.8	1.9	0.8				49	20	13.0	10.5	+18	—21	0.0	0.0
24E	1910	23.2	5.6	2.5	62.8	3.4	1.0	1.0				35	40	10.5	7.5				
	1932	20.7	5.8	2.7	62.8		1.8					50	22	11.0	8.0	+15	—18	0.0	0.0
25E	1909	22.6	7.8	2.5	61.3	2.3	1.7	1.8				17	52	16.5	7.5				
	1933	22.7	6.3	2.4	64.6	1.5	1.6	0.8				40	35	12.5	7.5	+23	—17	—4.0	0.0
26E	1909	21.0	7.3	2.8	61.1	3.3	1.5	2.5				32	36	14.5	8.5				
	1929	20.1	6.9	2.4	62.9	3.1	1.8	1.8				48	22	14.0	7.5	+16	—14	0.0	0.0
27E	1909	21.0	7.7	2.7	61.8	3.0	1.6	0.7	.26	.56	.78	32	35	16.0	8.0				
	1932	21.2	6.7	2.3	62.6	3.4	1.8	1.3				41	30	14.0	7.0	+ 9	— 5	—2.0	0.0
28E	1909	21.7	6.7	2.4	62.0	3.4	1.5	1.1	.44	.72	.22	34	36	13.5	7.5				
	1932	19.9	7.2	2.4	62.8	3.1	1.9	1.5				47	22	15.0	7.5	+13	—15	+1.5	0.0
29E	1909	23.4	7.0	2.7	60.9	1.1	1.4	2.8				16	55	14.0	8.0				
	1932	21.6	6.5	2.4	65.4	1.5	1.5					51	24	13.0	7.5	+35	—31	0.0	0.0
30E	1909	23.0	6.1	2.2	63.5	3.5	0.9	0.7	.03	.20	.20	37	38	12.5	6.5				
	1932	21.3	5.5	2.2	63.8		1.7					53	21	11.0	6.5	+16	—17	—1.5	0.0
31E	1909	22.5	6.5	3.6	62.0	0.7	1.6	1.5	.29	.52	.95	28	43	11.0	11.0				
	1932	21.0	7.2	3.7	64.4	1.0	1.9	0.7				44	27	13.0	11.5	+16	—16	+2.0	0.0
32E	1909	19.8	8.4	2.7	61.3	1.8	1.5	3.0				35	30	17.5	8.0				
	1932	20.3	7.0	2.3	64.3	2.0	1.9	1.4				52	19	14.5	7.0	+17	—11	—3.0	0.0
33E	1909	21.1	7.8	2.3	63.4	2.4	1.5	0.1	.42	.57	.41	37	32	16.5	7.0				
	1932	19.9	7.2	2.9	63.3	2.6	1.8	1.0				48	21	14.0	9.0	+11	—11	—2.5	+2.0
34E	1909	22.1	7.0	2.3	62.3	2.3	1.5	1.4	.31	.57	.43	31	39	14.5	7.0				
	1932	18.5	7.1	2.9	63.4	2.9	1.9					61	7	14.0	9.0	+30	—32	0.0	+2.0
35E	1909	22.2	8.9	2.3	60.8	1.3	1.5	1.7	.12	1.14		11	56	19.5	7.0				
	1932	20.6	6.5	2.9	65.4	1.7	1.6	0.8				58	16	12.5	9.0	+47	—40	—7.0	+2.0
36E	1909	22.7	5.6	4.5	62.2	0.6	1.0	2.0	.17	.19	.88	34	40	7.0	13.5				
37E	1909	20.4	3.6	9.0	61.4	0.8	1.2	1.1	1.54	.24	1.01	49	22	0.0	17.0				
38E	1909	19.5	7.6	6.9	63.1	0.9	1.4	0.2	.24	.51		44	22	8.5	21.0				
39E	1909	23.0	7.2	2.5	63.6	1.0	0.4	1.2	.23	.63	.27	31	43	15.0	7.5				
40E	1909	20.3	7.1	4.1	61.7	2.3	1.5	2.1				39	29	12.0	12.5				
41E	1909	23.4	3.0	7.5	61.9	0.5	1.7	0.5	.20	.28	.69	34	42	0.0	14.5				

| Ig. Loss does not include CO_2 when CO_2 was determined.

*A = Late 3C.S minus early 3C.S (indicated as 0 unless greater than 3 per cent).
*B = Late 2C.S minus early 2C.S (indicated as 0 unless greater than 3 per cent).
*C = Late 3C.A minus early 3C.A (indicated as 0 unless greater than 1 per cent).
*D = Late 4C.A.F minus early 4C.A.F (indicated as 0 unless greater than 1 per cent)

3C.S = $3CaO.SiO_2$
2C.S = $2CaO.SiO_2$
3C.A = $3CaO.Al_2O_3$
4C.A.F = $4CaO.Al_2O_3.Fe_2O_3$

of a cement calculated from oxide analyses as a basis of study that they should bear in mind the approximate character of such calculations. No fine distinction should be drawn between cements showing a few per cent difference in one or more of the constituents.

Censure, if any, for the present condition should not be directed toward the manufacturer as much as toward investigators generally. The latter are the ones who stressed strength to the exclusion of other properties. No wonder, then, that all other properties were lost sight of. It is therefore most pleasing to note that present views are tending to place strength in the background and bring to the fore other properties, such as volume change, durability, heat of hardening, etc., and particularly that they are connecting these properties with the physical and chemical values of the cement.

Progress in Cement Strength Revealed by Long-Time Tests

Strength records over a long period of years give a quantitative measure of the progressive raising of strength

A GRAPHICAL representation of the progress in the strength of commercial cement during a period of more than fifteen years is reproduced herewith, from data recently prepared from the test records of the Portland Cement Association. Long-time tests begun in 1916, including specimens preserved until now, are the basis of the work, which presents curves of increase of strength with age, grouped to show how the strength characteristics of cement have changed from 1916 until now.

Fig. 1 gives the essential data on the progressive increase of strength in cement made during the last sixteen years. The left diagram, which is plotted to arithmetical scale, brings out clearly the advance in the strength of cements made during the past decade, as compared with those made prior to 1920. Further detail is brought out in the right diagram, in which time is plotted to logarithmic scale. It will be seen that the rate of gain in strength is about the same for all the groups, but the 1916-1920 and 1921-1925 cements show a continuous increase for periods of as much as ten years, while the two later cement groups give evidence of tending toward a maximum in strength at earlier periods.

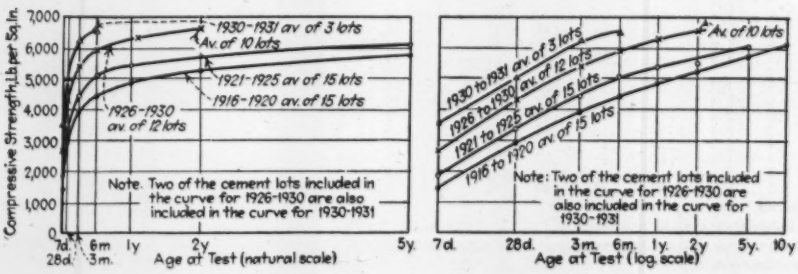


Fig. 1—Progressive increase of cement quality shown by five-year grouping of compression-test records on concrete. The dates noted on the curve represent the period during which the cement was bought. All tests were made on 6x12-in. cylinders in 1:5 mix, with aggregates up to 1½ in. in size and 6.1 gal. of water per second. Specimens were cured in moist air until the time of test. Note progressive increase of strength between successive five-year periods, and also the long-continued rise in strength, the earlier cements showing a steady gain up to the ten-year period represented. The results are shown on both natural and logarithmic abscissa scales to bring out the strength-time relation clearly. The logarithmic plot reveals practical uniformity in rate of strength gain.

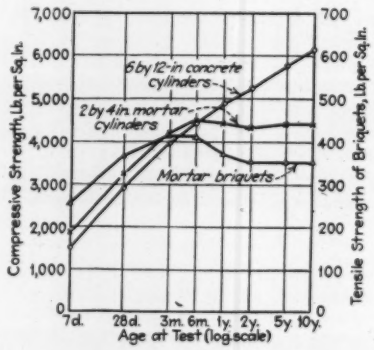


Fig. 2—Concrete gains in strength while mortar specimens in compression and tension reach a maximum at three months. These tests, showing the lack of correlation between cement strength and concrete strength, were made on cement purchased and molded during the five years 1916-1920. The mortar specimens, of 1:3 mix, were cured in water until test, and were tested damp; the data for the concrete specimens are as given in connection with Fig. 1.

It is worthy of special note that the upper curve, for cements made in 1930 and 1931, represents the influence of the strength increase provided by the standard cement specification adopted by the A.S.T.M. in 1930.

Chemical analyses and fineness measurements indicate that the high early strength of the later cements is due in part to changes in chemical composition and in part to greater fineness, though the two separate effects could not be isolated.

That these characteristics of concrete strength differ decidedly from the strength relations of mortar specimens is well brought out by Fig. 2, representing concrete cylinder tests compared with mortar cylinder (compressive) and briquet (tensile) tests on cements of the 1916-1920 group, tested at various times up to ten years' average age. The mortar specimens in both tension and compression reached their maximum at three to six months of age and then slightly declined or held to a constant value, while the concrete specimens gained in strength almost uniformly throughout the ten-year period.

In all cases, it should be noted, the cements included in the tests were mixtures of four or five commercial brands bought from local dealers. The series of tests was begun in 1916 at Lewis Institute, Chicago, and has been continued systematically ever since. Corresponding tests of specimens stored dry have apparently not been made.

Code for Compressed-Air Work Soon To Be Developed

The development of an American standard safety code for work in compressed air is to be undertaken by a national committee of engineers and accident-prevention experts working under the auspices of the American Standards Association, New York. The work is to be undertaken at the request of the International Association of Industrial Accident Boards and Commissions.

The scope of the project will include construction and operating rules for work in caissons, tunnels, or wherever workers are subjected to air under pressure higher than atmospheric (including protection from mechanical hazards), the use of necessary instruments and apparatus, provision of locks, methods of lighting, communication and decompression, the keeping of records, medical attendance, periodic inspection and air analysis, rest rooms, hours of labor, sanitation, ventilation, fire prevention, fire protection, temperature control, and other conditions of work.

Proposed New Building Code for New York City—I

Comparison with code now in force reveals radical change in make-up, increases in working stresses of building materials, reductions in floor loads, permission of structural welding, recognition of "controlled" concrete and better foundation provisions

By Rudolph P. Miller

Consulting Engineer, New York, N. Y.

IN OCTOBER, 1928, the mayor of New York requested the Merchants' Association to undertake the revision of the city's building code, which was then about thirteen years old. Instead of revision, an entirely new code resulted from four years of conscientious work on the part of twenty committees, with a total personnel of 125, under the general supervision of a planning and co-ordinating committee of which the chairman was John Lowry, of John Lowry, Inc., builders. The committees enlisted the aid of the best technical talent of the city. The code is of national importance because New York building practices have a bearing on construction the country over. Also, the old New York code was used as a model for many other city codes, and the changes made in it are of wide interest. In this article the general provisions of the code and the requirements for foundations and masonry construction are outlined. A second article, next week, will consider floor loads, reinforced concrete, steel and wood construction and fire-resistive requirements. The author, an authority on building-code work, was superintendent of buildings of New York City for many years and was instrumental in drafting the 1915 code and securing its adoption. He is, therefore, on familiar ground when he compares the proposed new code provisions with the old ones. —EDITOR.

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WHEN does a building code become obsolete? The question is not easily answered, as there are many factors that must be considered in arriving at a determination, among them the time when it was enacted, the changes in materials and practices in building construction that have since developed, local policies, increase in the population of the community and the character of the occupations of the inhabitants. A compilation made by the building code committee of the U. S. Bureau of Standards in 1930 may give some idea of the life of a building code. Of the 37 cities of the United States whose population, according to the census of 1930, exceeded 250,000, fourteen reported that revision of their building codes was either in progress at the time or in contemplation; the other 23 apparently were content with the codes then in force, the average life of which was about 4½ years, the oldest having been adopted 13 years previously. Of those under revision one had served the city for 33 years; four of them were stated to be only 2 or 3 years old; the majority varied in age from 14 to 24 years. The average life of all was about 15 years.

Make-up of proposed code

In the proposed new code for New York City, a commendable attempt has been made to depart from the former tendency toward detailed specification in code writing, the result of which inevitably is to restrict designers and constructors in planning and to hamper the development of new materials and construction. The flexibility that is desired to avoid these drawbacks of the specification type of code is sought to be provided in the new code by separating the fundamental requirements, which are intended to be fairly permanent, from the specific provisions, which should be capable of easy and prompt revision whenever the necessity arises. In the code as published the basic requirements—those that are to constitute the ordinance—have been printed in italics; while the detailed provisions, which are considered merely as rules subject to change as already indicated, appear in Roman type. The intention apparently is to have the board of aldermen adopt the entire body of provisions, so that the enforcing authorities will not be without definite guides in the interpretation of the ordinance when it becomes effective, and then transfer further jurisdiction over the rules to the board of standards and appeals.

The legality of this procedure is questionable. The board of standards and appeals, created by the state legislature, is charged with the specific duty, among others, to make, amend and repeal rules for carrying into effect the provisions of ordinances relating to the construction of buildings. By the city charter the authority has been conferred upon the board of aldermen to enact an ordinance known as the building code, which may be as detailed as that body may see fit. But when a provision has been incorporated in that statute it cannot be made ineffective or modified by any other body than that which enacted it. Nor can the power to amend or modify by rule such a provision be delegated to some other body. Under certain conditions the board of standards and appeals may, in individual cases, permit a variance from a specific provision of the building code, but it cannot do so by rule. Its rule-making power is limited to prescripts intended to carry into effect statutory provisions. The distinction between ordinance and rule should be kept in mind in any discussion of the proposed New York building code.

In its broad outline the arrangement of the proposed code follows generally the recommendations of the building code committee of the U. S. Department of Commerce as given in the report of July 15, 1925. There are sixteen articles in the New York code against nineteen proposed by the government committee. The difference is due to the omission of certain articles, dealing with zoning, electrical control and signs, which in New York City are regulated by other ordinances. In the elaboration of the necessary subdivision of the articles, local policy and preferences naturally caused a departure from the detailed suggestions of the government code.

The technical requirements, recommended by the various committees of experts, which are more generally included in the rules than in the code, are intended to embody the most recent knowledge of the materials and the latest acceptable practices in building construction. While space will not permit a close analysis of all the changes from the present code requirements, a general survey to point out the more important differences between the old and new is here presented.

Foundation provisions

In dealing with foundations the proposed code, with some exceptions, accepts generally the provisions of the present ordinance, but with an elaboration of details. It requires fuller information as to the soil conditions before the permit is issued, or, if strictly interpreted, at the time the application for the permit is filed. Under past practice a report on subsoil conditions was required by the building authorities only when unusual or doubtful conditions developed at the time the excavation was undertaken. It is now proposed to require records of borings or test pits to satisfactory bearing material certified by a licensed professional engineer or registered architect. At least one boring or test pit shall be made for each 2,500 sq.ft. of building area. For buildings more than 75 ft. high or where the total load on the area of the structure is in excess of 1,000 lb. per sq.ft. the information shall cover conditions to bedrock. In the case of buildings less than 50 ft. high, designed for maximum live loads of 75 lb. per sq.ft., the requirement for such records may be waived. Wash borings are prohibited.

Soil Loading—As satisfactory bearing material, rock, sand, gravel and clay,

or any combination of them, are specified. Filled material, mud, silt, organic material and any of the satisfactory materials containing an appreciable amount of organic material are assumed to have no bearing capacity. The presumptive bearing capacities of acceptable soils are the same as those enumerated in the present code. These materials are separated into five classes to furnish a basis for reducing the allowable loads on the weaker soils when materials of varying bearing values must be used under a single building. When footings are more than 10 ft. below curb, the presumptive capacities may, "in the discretion of the superintendent," be increased 100 lb. for each foot of depth, at the footing level, in excess of 10 ft. below curb, provided the bearing capacity is not increased more than 50 per cent. Greater values than the specified capacities are permitted if a prescribed load test shows that the desired working load does not cause a settlement of more than ¾ in., nor an increase of 60 per cent in the actual settlement under the required 50 per cent overload.

Footings—In the design of footings the proposed and existing codes are in agreement regarding the loads to be transmitted to the underlying soil. The present code requires that footings shall be so designed that the loads on the soil are approximately uniform throughout the building area and within the bearing capacity of the soil. To this end, a method of proportioning the footing areas according to dead loads alone is prescribed. The proposed code merely provides that they "shall be so designed as properly to distribute their loads within the allowed bearing capacities." Specific provisions for the design of footings of reinforced concrete are made (R 8.5.28). [Editor's Note—A few references are made to specific ordinance paragraphs (§) and to specific rules (R) for those readers who have a copy of the code available.]

Piles—The same types of pile foundations recognized in the present code are provided for in the proposed code by more elaborate specifications and marked changes in allowable loads. Other types are not precluded if they meet "all requirements which may be established by the rules of the board" in addition to those already prescribed. A record of the total penetration of every pile and its behavior during driving is required, though there is no requirement that such record shall be filed with the building authorities or othewise preserved. *Engineering News* formulas, limited by the present code to wooden piles, are made applicable to all types of friction piles "as an approximate indication of the allowable load." As in the present code, the superintendent of buildings may order a load test when any doubt exists as to the safe sustaining power of a pile or group of piles. The applied test load must be 1½ times the proposed working load; and the total net settlement, after standing for 24 hours without further settlement, must not exceed 0.01 in. for each ton of the total test load. Jetting of piles is permitted only on special approval of the superintendent of buildings.

The maximum load on timber piles is reduced from 20 to 15 tons, unless extra large piles with points 8 in. or more in diameter are used. The minimum penetration must be 12 ft. Precast concrete piles must be reinforced vertically (2 per cent or more), and laterally with hoops or spirals (at least ¼-in. round rods or wire spaced 12 in.). Generally a greater slenderness ratio is allowed by the proposed code (exact comparison is difficult); but the maximum permissible loads (tabulated according to average diameters) are less than now allowed, by one-third and more. While the minimum dimensions of cast-in-place concrete piles remain about the same as under the present code, the proposed allowable load is considerably higher. Such piles (11 in. in diameter) at present have a capacity of 16.6 tons (350 lb. per sq.in.), but would, as proposed, carry safely 30 tons (630+ lb. per sq.in.); though this is prescribed as the maximum, provided that when the point of the pile is 15 in. or more in diameter and the pile bears upon a stratum of gravel or better bearing material, the allowable load may be increased, at the discretion of the superintendent of buildings, at the rate of 2 tons for each additional inch in diameter over fifteen, but not to exceed 40 tons in any case.

With respect to concrete-filled steel pipes used as piles the proposed code is decidedly more liberal than the present code. Only one splice in the pile is now permitted; whereas there would be no limit in this respect, though if they are closer than 20 ft., a 5 per cent reduction must be made in the allowable load for each splice within 20 ft. of another. The present maximum slenderness ratio of 40 is intended to be maintained. But provision is made that, if unforeseen conditions in the field necessitate a somewhat greater ratio, a 1 per cent reduction in the working load shall be made for each diameter of excess length. In fixing the allowable loads on these piles, it is assumed that they rest on rock, which is also a specific requirement of the present code. The capacities under the two codes, for the minimum pipe thickness (⅛ in.) are:

	Pipe Diameters, Inches							
	10	12	14	15	16	18	20	22
Proposed Code (tons)	55	70	80	90	100	120	140	150
1915 Code.	38.3	50.3	64.0	71.8	79.5	96.5	115.4	135.8

The new values would be reduced 30 per cent if the pipes rest in "cemented hardpan continuous to bedrock," except that the maximum in any case would be 70 tons. If boulders or a mixture of gravel and boulders is encountered and further driving is stopped, the reduction shall be 50 per cent, with a maximum load of 50 tons. When stopping in other material, the piles shall be treated as friction piles. Combinations of these several types would be permissible, in which case the allowable loads would be fixed by the weakest section.

Piers — When concrete-filled steel pipes are more than 22 in. in diameter they are classed, under the proposed code, as reinforced-concrete piers, which apparently makes them subject to the provisions applying to foundation piers. Whether this latter term is also intended to include open or pneumatic caissons is not clear. The word caisson does not appear in the proposed code.

Foundation piers shall be at least 2 ft. in their least dimension and are to be so installed that they allow of inspection of the surface on which they are to rest. They may be constructed of masonry or reinforced concrete. If of plain concrete, the height is limited to twelve times the least horizontal dimension. When the pier is less than 6 ft. in least horizontal dimension and the height is more than six times that dimension, the working stresses in the concrete, as elsewhere prescribed in the code, shall be reduced by applying the factor 1.3—*H/20D;* but in no case shall the compressive stress be taken at more than 850 lb. per sq.in. If constructed of reinforced concrete, the construction shall, with certain specified modifications, comply with the provisions applying to that material. If a pier is incased in a steel shell not less than ⅜ in. thick, such shell may be taken as spiral reinforcement, up to the efficiency of the vertical splices, and may be used as vertical reinforcement up to the efficiency of the horizontal joints in tension.

Safety of Adjoining Buildings—The provisions fixing responsibility for the support and safety of adjoining buildings during excavation operations are retained in the proposed code substantially as they appear in the present code. The 10-ft. depth, so long and well established for New York by statute as the point at which the responsibility transfers from one to the other of adjoining owners, is not changed. An effort has been made to secure, more definitely than is now the case, for the party making an excavation, the necessary access to adjoining property to protect it and to avoid deliberate obstruction in proceeding with the work.

Old and new masonry provisions

Masonry is defined in the ordinance as "stone, brick, concrete, hollow tile, concrete block or tile, or other similar building units or materials or a combination of them, bonded together with mortar," the same as at present, except that it specifically refers to the possible use of materials, either new or now

mentioned in the code. These materials must comply with the rules of the board of standards and appeals. For the introduction of materials not specified in the rules it is provided, indirectly rather than specifically (§2.2.3), that they shall be subjected (as the present code also requires) to such tests to determine their suitability as the superintendent of buildings may direct. Masonry materials are to be tested in accordance with one of three A.S.T.M. standards: solid units by C 62-28T (This is possibly intended to mean the later standard C 62-30); hollow units by C 34-27 (C 34-31 ?); and monolithic construction by C 39-27. These rules will supersede the less comprehensive rules for the testing of new masonry materials adopted by the superintendents of buildings in 1905 and affirmed by the board of standards and appeals in 1917.

Brick—Of the materials enumerated in the definition of masonry, clay brick shall meet the specification for "B" brick of the A.S.T.M. standards C 62-30. Undoubtedly it is not intended to preclude the use of "A" brick, though strictly interpreted the provision would do so. No standard is set for sand lime or concrete brick; but by the definition of brick as a unit (approximately 8 by 3¾ by 2¼ in. in size), these, as well as fire-clay brick, meeting the requirements for "B" clay brick, shall be considered as brick. Other "solid structural units" having a gross volume at least 50 per cent greater than a brick when made of clay are also required to meet the "B" brick standard. The proposed standard for brick does not materially differ from the present standard, which requires an average compressive strength (five samples) of 3,000 lb. per sq.in. and a modulus of rupture of 450.

Clay Tile—For structural clay tile, termed "hollow tile" in the definition of masonry, A.S.T.M. C 34-31, medium grade, is set as the standard of quality when used for bearing walls or for walls exposed to weather; and A.S.T.M. C 56-31, when used for partitions. This means that the required average gross compressive strength is somewhat higher than that specified in the present code: 1,400 against 1,200, when tested with cells vertical; and 700 against 300, with cells horizontal.

Concrete Block—Irrespective of the manner of testing, of the age of the sample or of the nature of the aggregate, concrete blocks or tile when delivered for use must develop a minimum compressive strength of 700 lb. per sq. in. of gross area as laid in the wall, in the case of hollow blocks; and 2,500 lb. in the case of solid blocks. The distinction between solid and hollow blocks depends on the net cross-sectional area—whether more or less than 75 per cent of the gross area. The present code makes no such distinction and fixes a uniform strength requirement at 28 days, regardless of the percentage of cellular space, of 750 lb. when tested with the cells vertical and 300 lb. with cells horizontal, based on gross area. It is a little difficult to understand why the concrete of the solid block must be about 2⅜ times as strong in the solid block as in the hollow block, especially when the ratio of working stress to ultimate compressive strength is the same for both.

Stone is another of the masonry materials. In neither the present nor the proposed codes is any provision made for quality. On the other hand, gypsum block or tile, although not mentioned in the definition as a masonry material, is included as such in the rules and is required to meet the A.S.T.M. specification C 52-27.

Plain Concrete—When concrete is listed in the definition of masonry, "plain concrete" is no doubt meant. It is limited to a mixture "of at least 1 part of cement to a total of 5½ parts of separate volumes of fine and coarse aggregate, measured dry, and a maximum of 7½ U. S. gal. of water (including that contained in the aggregate) per sack of cement" and must "develop a strength of at least 2,000 lb. per sq.in." This is a richer and stronger mixture than contemplated by the old code, which prescribed 1 part of cement to "not more than 2½ parts of sand and 5 parts of coarse aggregate."

Masonry working stresses

Changes in the allowable working stresses in masonry, as given in the rules, are listed in the table below.

No provision is made for permissible loads on rubble masonry, although three types are defined: rough or ordinary rubble; random rubble; and coursed rubble. In accordance with another rule (R 7.4.2.8) the working stresses for these types "shall be 30 per cent of the minimum ultimate compressive strength of at least three full-size wall panels at least 9 ft. high." The rule would also apply to cyclopean or rubble concrete not otherwise provided for.

Mortar—The appropriate A.S.T.M. standards are cited as the specifications for the bonding materials of masonry, to wit: quicklime, hydrated lime, cement and gypsum. As only the standard for portland cement (A.S.T.M. C 9-30) is prescribed and the definition of cement limits the term to material complying with that standard, presumably portland cement is the only cement permissible in building construction. The several mortar mixtures remain as provided in the present code except that a richer mixture is required in the case of lime mortar (R 7.1.1.8.2). A limitation fixing the "maximum proportion by volume of sand to cementing material" at 3 to 1 is incorporated in one of the rules.

Bearing walls

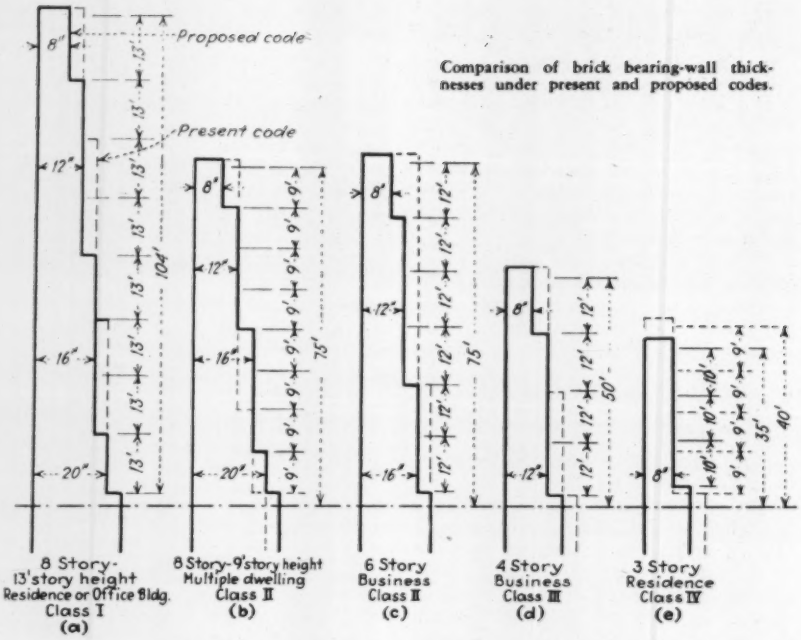
The requirements controlling masonry construction are generally the same in the present and proposed codes, the latter being more detailed and somewhat less conservative. The proposed code is more liberal in fixing the limiting percentage of openings in a horizontal section of a bearing wall at 50, as against the present 30, before requiring an increase in the minimum thickness of the wall (R 8.4.1.6). The treatment of hollow walls of solid units (brick) apparently is intended to authorize definitely the use of the so-called "ideal wall" (R 8.4.3.1.1). A ruling under the present code prohibited that form of construction, though there is good reason to belive that by a liberal interpretation such a wall could be allowed.

Although there is no limiting height specified to which brick bearing walls may be erected, the fact that no provision is made for more than eight stories practically fixes the limit at a few feet above 100 ft. Thirteen feet is prescribed as the maximum height that may be assumed for a story (height of a story is defined as "the vertical distance from top to top of two successive tiers of floor beams"). In the diagram on p. 498 the minimum thicknesses for brick bearing walls prescribed by the new and

MASONRY WORKING STRESSES UNDER OLD AND NEW CODES

Type of Masonry	Mortar	Compressive Stress on Gross Area Lb. Per Sq.In. Proposed	Present
Brick:			
Solid wall	Portland cement	325	250
Solid wall	Natural cement	(a)	210
Solid wall	Cement-lime	250	160
Solid wall	Lime	100	110
Hollow wall	Portland cement	150	(a)
Hollow wall	Cement-lime	125	(a)
Hollow wall	Lime	50	(a
Structural clay tile:			
Cells vertical	Portland cement	125	100
Cells vertical	Cement-lime	100	(b)
Cells horisontal	Portland cement	70	50
Cells horisontal	Cement-lime	60	(b)
Concrete block or tile:			
(Net cross-sectional area less than 75%)			
Cells vertical	Portland cement	70 (c)	75
Cells vertical	Cement-lime	58 (c)	(b)
Cells horisontal	Portland cement	70 (c)	30
Cells horisontal	Cement-lime	58 (c)	(b)
Plain concrete			
1:5½		500	(a)
1:2:4		(a)	500
1:2½:5		(a)	400

(a) No provision made. (b) Not permitted by code. (c) If the units show a greater compressive strength than 750 lb. per sq.in., the value may be 1/10 and 1/12 of the crushing strength, for cement and cement-lime mortar respectively



Comparison of brick bearing-wall thicknesses under present and proposed codes.

present codes are shown. The heavy lines show the new requirements; the dash lines show the present ones. An eight-story wall would be 104 ft. high, if the stories are of maximum height. It need not, however, be more than 72 ft. high, keeping within the limiting height for residence buildings of non-fireproof construction. In the first instance the new provision would afford a saving of masonry in five stories; in the second, the saving effected in the top story would be more than offset by the extra brickwork in the first, third and fourth stories. That bearing walls are likely to be used for buildings over 75 ft. in height is doubtful, for over that height skeleton-type construction would be more economical. For business buildings of that height there would be a saving in the bearing walls of 4 in. of brickwork for the full height and an additional 4 in. in the top story (refer to *c*). There would also be an advantage under the proposed code in business buildings of non-fireproof construction, limited to a height of 50 ft. An exception to the general rule as to wall thicknesses is made for private dwellings not over 35 ft. in height, in which an 8-in. thickness is permitted for all stories; in the present code the 8-in. walls are permitted for a height of 40 ft.

Interior walls in residence buildings, without restriction as to type of masonry, are limited to six stories, probably on the assumption that they will be used only in buildings of non-fireproof construction. Such walls need be only 8 in. in thickness through the uppermost four stories and 12 in. below that, provided, however, that they are buttressed at intervals of 30 ft. and, in case they support wooden floor beams on both sides of the wall, they shall be increased to 12-in. thickness throughout.

Hollow walls of brick are limited in height to 40 ft. The allowable minimum thickness is the same as that of the upper section of brick bearing walls, and this type of wall may replace the upper section of a solid brick wall provided the lower section is not more than 30 ft. high above the first tier of beams.

A similar limit of 40 ft. in height is set for walls of structural clay tile and concrete blocks, as is the case in the present code; and under the same condition imposed for hollow walls of brick they may be superimposed on solid walls of brick. A 10-in. minimum thickness is prescribed for the upper two stories, increased to 12 in. below that.

Walls of plain concrete, ashlar masonry or rubble presumably may be erected to the same height as brick walls. The minimum thicknesses may be 2 in. less for plain concrete, with a minimum of 8 in.; for ashlar masonry walls the same minimum thicknesses as for brick are prescribed; while in the case of rubble an increase of 4 in. throughout is required. Rubble walls are now limited to 60 ft. in height, and plain concrete walls must be of the same thickness as brick walls.

In the case of panel walls (curtain walls in skeleton frames) the thickness must be at least 8 in. when constructed of solid masonry, 10 in. when constructed of a solid masonry facing and a hollow masonry backing, and 12 in. when constructed of hollow masonry throughout. An increase of 4 in. in thickness is required when such walls exceed 13 ft. in height. The present code fixes a minimum thickness of 12 in. in any case, increasing 4 in. when the height exceeds 20 ft.

Foreign Bridges Exemplify Unusual Designs

EUROPEAN magazines during the past few years have published accounts of the design and construction of many unusual foreign bridges. Descriptions of the larger and more important of these structures have appeared in these pages at various times. But space has not permitted detailed consideration of all of the bridges that contain some element of interest to American engineers. In this article, therefore, illustrations and brief descriptions of some of these unique structures are presented. Examples are chosen both for their novelty and instructional value. References are given to the European magazines in which more extended accounts have appeared.

Unsymmetrical three-hinged steel arch

In *De Ingenieur* of Oct. 16, 1931, Prof. Bijlaard describes an unsymmetrical three-hinged arch built over the Kali Progo on the Batavia-Soerabaja line in the Dutch East Indies. The hinges are at the points *A, B* and *C*, shown in Fig. 1. By the horizontal force in the short member *BC* the compression in the upper chord and the tension in the bottom chord are decreased so that a 40 per cent money saving is made for the main chords. It was also possible by this design to save concrete in the abutments. On this bridge 3,130 cu.yd. of concrete was used at the left end and only 1,040 cu.yd. at the right end.

Through-type concrete cantilever

In *La Technique des Travaux* for October, 1931, G. Abraham described a reinforced-concrete cantilever bridge near Vaux sur Yonne. The existing piers of the old bridge had to be used, and a concrete cantilever bridge with

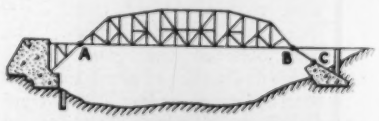


Fig. 1—A simple truss bridge, in the Dutch East Indies, which is so supported as to act like a three-hinged arch.

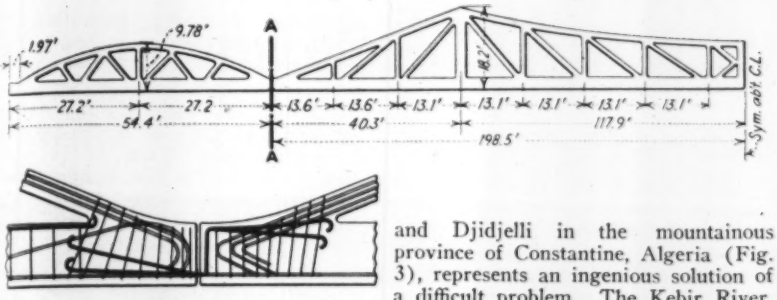


Fig. 2—Through-cantilever span of reinforced concrete in France. The hinge connecting the outside span to the main span is designed to transmit tension only.

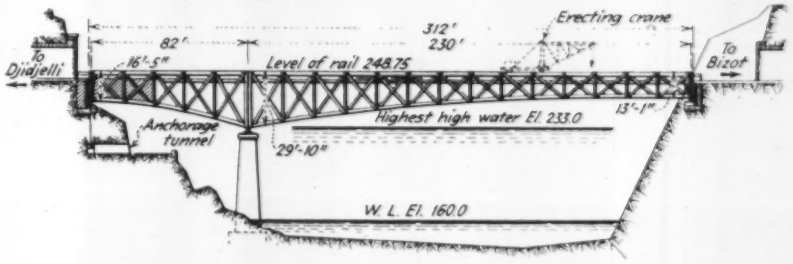
two small suspended outside spans of 54.4 ft. was developed to meet the conditions. The middle span is 117.9 ft. long. The top and bottom chords have the same cross-section from end to end, 17.7x33.5 in. and 9.85x17.7 in., respectively. The distance center to center of chords is 19.8 ft.

The pavement is of reinforced concrete 7.1 in. thick with a 2-in. asphalt wearing surface. Three stringers are used between the floor beams, which span from joint to joint. The pavement is 13.6 ft. wide, and there are two sidewalks 1.8 ft. wide. The hinges are designed for tension only, as shown in Fig. 2. This bridge is reminiscent of one built several years ago at Montrose, Scotland (*ENR*, Aug. 20, 1931, p. 300).

Unsymmetrical spans eliminate falsework

The new steel bridge recently completed on the railway line between Bizot and Djidjelli in the mountainous province of Constantine, Algeria (Fig. 3), represents an ingenious solution of a difficult problem. The Kebir River, which it crosses, is a flashy stream, subject to sudden and high floods. The rocky banks are steep, one being quite precipitous, while the other slopes more gradually and is benched to provide for a highway along the river. The winds in the valley, which is about 1,000 ft. deep and one-half mile wide, are of unusually high velocity. The railroad is in tunnel on either bank of the river, and the opening to be bridged was 312 ft. An account in *Le Génie Civil*, May 21, 1932, describes the solution.

Fig. 3—By placing a simple pier near one bank of the river and by using an unsymmetrical-span layout, falsework was eliminated in building this railway bridge in Algeria.



Falsework was undesirable because of the local conditions. This eliminated consideration of an arch bridge. A structure of two or three symmetrical spans would have required piers in the river, with all the risks which that carried. On the contrary, by dividing the length of 312 ft. into two uneven spans, one of 230 ft. and the other of 82 ft., it was possible to locate the single pier required on solid ground at about normal water level. As shown in Fig. 3, the truss is 29 ft. 10 in. deep over the pier and 16 ft. 5 in. and 13 ft. 1 in. deep at the ends. The width is 18 ft. 2 in.

In constructing the bridge the pier was built by laying up a facing of rough stone into which the mass concrete was poured. The pier was topped with a cap of reinforced concrete. Construction of the abutments was carried out at the same time. The erection of the steelwork commenced with the short span, which was set on light falsework. A 5-ton crane with a 25-ft. boom radius was used. The long span was erected as a cantilever, the short span being used as an anchor arm. Vertical anchorage rods were installed at the end of this span, tying it to the roof of a tunnel driven into the cliff at the level of the highway beneath the bridge. This anchorage was supplemented by a 310-ton concrete counterweight placed in the first two panels of the span. When erection was completed, the anchorages were removed, being no longer required for stability.

Suspended-cantilever bridge

A combination of cantilever and suspension principles has been used in a steel bridge outside of Paris, connecting the village of Billancourt with Séquin Island in the Seine River. The design is described in *Le Génie Civil*, June 18, 1932. An elevation and one of the anchorage details are shown in Fig. 4. The structure consists of a main span of 244 ft. and two side spans of 81.4 ft. In addition, there is an approach girder span of 62.7 ft. on the Billancourt end. The main span is made up of two cantilever girders 94 ft. long supporting on their outer ends a central portion 56.4 ft. long. The cantilever arms, instead of being anchored, are held up by

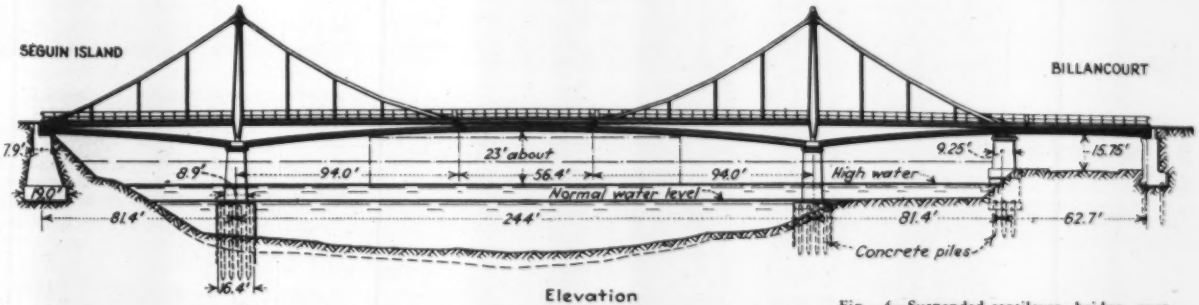
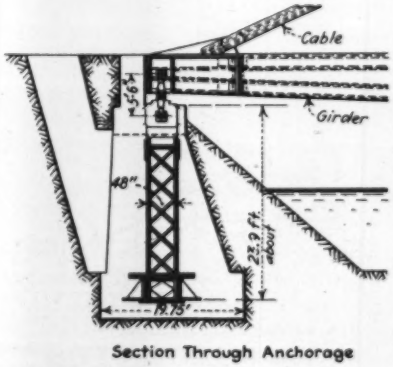


Fig. 4—Suspended-cantilever bridge over the Seine River outside of Paris. It accommodates a trolley line and two roadways.



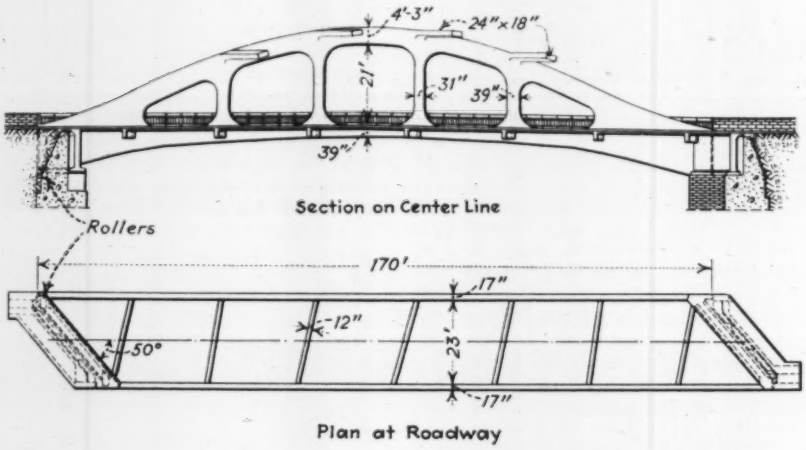


Fig. 5—The longest concrete Vierendeel truss bridge in France. Located in the Pyrenees Mountains, this type of design was chosen for economy and for esthetic suitability to the site.

a suspension system carried over the tops of 59-ft. towers on the piers. The main "cable" is H-shaped, built up of riveted plate flanges and a bar-laced web. Suspenders are four angles riveted together. The side-span beams are independent of the center-span cantilevers but are carried by the suspension system in the same manner. With this arrangement there are no horizontal loads to be resisted. Accordingly, the anchorage girders have to resist upward forces only; and to assure that they will not be subjected to any sidewise pull, they are joined to the bridge girders by a double-pin link as shown in Fig. 4.

The deck of the bridge consists of a 10-ft. strip in the center for trolley tracks, with 8.5-ft. roadways on either side separated from the center strip by 6-in. concrete curbs. In addition, sidewalks are accommodated. The design of the bridge was developed and patented by Etablissements Dayde, the contractor.

Concrete Vierendeel truss

In *La Technique des Travaux* for August, 1931, is described a concrete Vierendeel truss bridge of 170-ft. span, said to be the largest of its type in France. It crosses the Pique River a little above Luchon in the Pyrenees Mountains. Because it was necessary to build a bridge on existing abutments that could receive only vertical reactions, some sort of simple truss was required. Comparative studies showed the Vierendeel truss to be most economical. The bridge is on a considerable skew, as shown in Fig. 5. The roadway is 23 ft. wide and consists of 2½ in. of asphaltic macadam laid directly on the concrete. One end of the span is fixed, and one end is movable, being set on rollers operating between two cast-steel plates incased in the concrete.

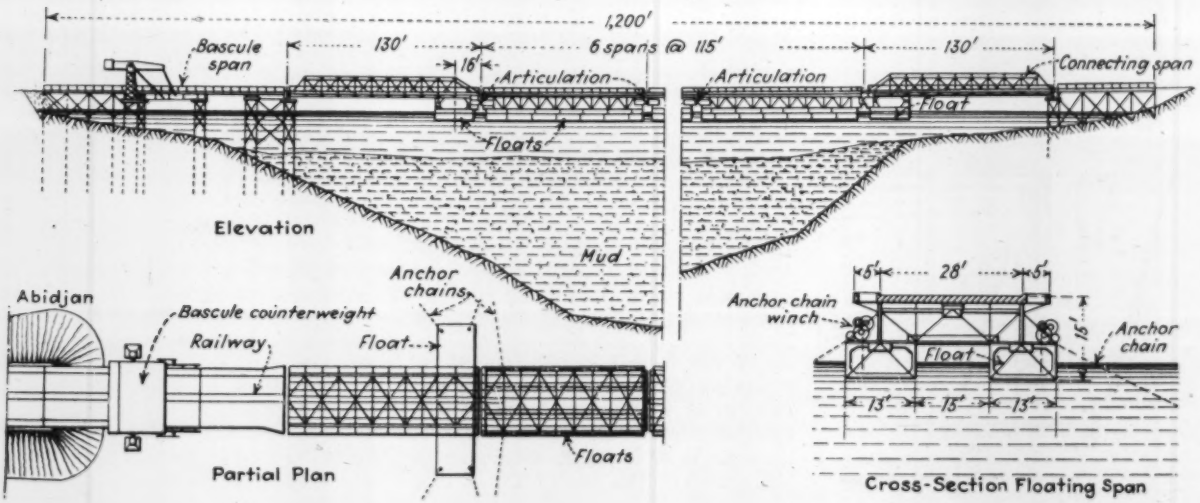
A floating bridge

On a new 9-mile-long rail line, connecting the city of Abijon in French West Africa with Port Bouet on the Gulf of Guinea, it was necessary to cross Ebrie Lagune, an inlet about 2 miles wide. Soundings showed that foundations for almost any type of bridge would be difficult to construct and exceedingly costly. Accordingly, it was decided to adopt a floating bridge for the greater part of the crossing, connected to land by steel trestle approaches at each end. In the Abijon approach a 33-ft.-span overhead-counterweight bascule is provided to pass boats. The bridge was designed and built by Etablissements Dayde and Schneider and provides a 28-ft. vehicle roadway and two 5-ft. sidewalks. The railway, which utilizes 39-ton locomotives, is placed along the center line of the roadway.

The floating bridge is shown in Fig. 6. The floating portion consists of six 115-ft. spans, each carried on pairs of metal floats placed lengthwise. The floats are 100x13 ft. and 6½ ft. deep, and each contains four bulkheads and interior bracing. At either end of this floating unit and connecting it to the trestle approaches is a 130-ft. pony-truss span. The outer ends of these connecting spans are also on floats, but these are placed transversely instead of longitudinally. The bridge is anchored by 180-ft. chains placed up and downstream and attached to submerged blocks of concrete. Provision is made for adjusting these chains to keep the spans in proper alignment.

To care for movements caused by moving loads and by tides, which have a range of about 5 ft., articulated joints are used between each floating span and also at the outer ends of the connecting spans. The bridge is level at low water. During high water the connecting spans are inclined, and, the floating part being level, a sharp break in grade occurs at the junction. In order to level this off and to produce a smoother vertical curve, provision is made for admitting ballast water to the floats at either end of the floating portion. The maximum grade on the connecting span, under the worst conditions, is about 4 per cent; and by admitting water to the floats this is reduced to 2 per cent.

Floats were substituted for difficult and expensive foundations on a combination highway and railway bridge in Africa.



Washington Monument Facts Brought Up to Date

Borings carried to rock for first time reveal a layer of soft clay potentially unstable under any large and unbalanced loading such as would result from the proposed landscaping operations

By Major D. H. Gillette
Assistant Director, Public Buildings and Public Parks of the National Capital, Washington, D. C.

RECENT INVESTIGATIONS made by an official committee of engineers and architects during the course of the preparation of a new plan for the Washington Monument grounds have disclosed some interesting foundation conditions. Briefly, the site is underlain with a blanket of soft clay over the rock which is at El.—60. This clay is of such character that any appreciable unbalancing of present loads on it, as contemplated in the extensive cut-and-fill operations of the proposed landscaping plan, would be extremely hazardous. Major Gillette reviews the history of the Washington Monument from its beginning, including the underpinning and straightening of 1880, the progressive settlement and the facts brought out by the latest committee. The present conclusion is that the monument is safe if undisturbed, but that any extensive shifting of weights must follow extension of the foundation to rock. Major Gillette states that in case the latter alternative is ever contemplated, it would probably be better to move the monument to a location where subsoil conditions are more satisfactory. —EDITOR.

EVER SINCE the city of Washington was established, the Monument grounds have been a fruitful source of plan and counter-plan. In 1783 came the first proposal for a monument to General Washington (in the form of a bronze equestrian statue, with the general in *Roman* dress!) to be located at the intersection of the north-south axis through the White House and the east-west axis through the Capitol. This point was found to be under the waters of Tiber Creek, so the site was moved to high ground several hundred feet to the southeast, where there was known to be a deposit of closely compacted sand and gravel. The 1783 monument was not built, but the site was never thereafter changed. It is the one upon which the present monument stands.

Many unsuccessful attempts were made between 1799 and 1826 to persuade Congress to build a Washington monument. Finally in 1833 the Washington Monument Society was organized to collect funds by popular subscription. On July 4, 1848, the cornerstone was laid, and by 1854 construction had reached the 150-ft. level. There was a spread footing 80 ft. square, with a shaft designed to reach to 600 ft. above the top of the foundation. Construction ceased in 1854, due to lack of funds, among other causes, and was not resumed until 1880.

In the interim the apprehensions as to the adequacy of the foundations had been aroused, because the then-existing portion had settled until the axis was leaning 1¾ in. to the north. Several analyses were made of the possible results of loading to the 600-ft. level, and great differences of opinion were stirred up. Before appropriating funds for completion, Congress in 1876 appointed a committee of engineers, headed by General Thomas Lincoln Casey, to examine the foundations. This committee reported that to excavate beneath and put a new foundation under the old one would be hazardous in the extreme, and recommended that the height of the proposed shaft should be decreased to 500 ft. and that the area and depth of the footings should be greatly increased.

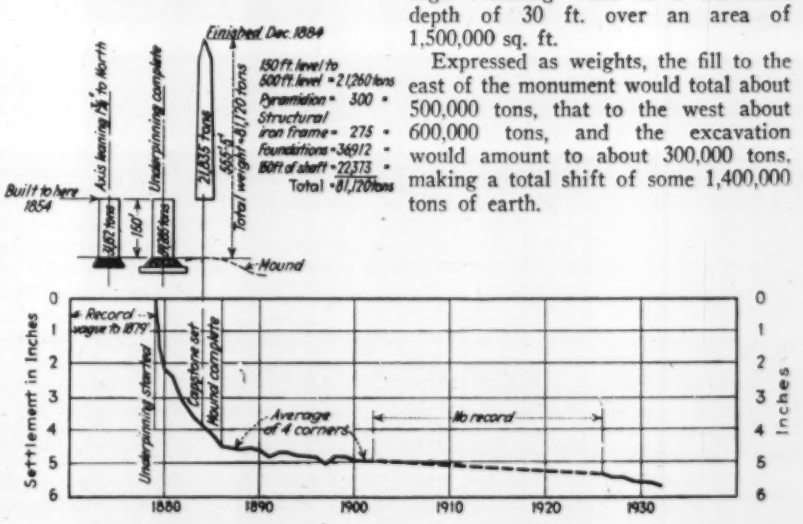
These recommendations later were carried out under the personal direction of General Casey, who developed a very skillful system of underpinning, which brought the axis back into plumb by progressive loading as the operation was carried out. Elaborate computations were prepared and a design was made "to give a maximum soil pressure of 9 tons per square foot, with an adequate safety factor against overturning in a wind of 145 miles per hour," a velocity greatly in excess of the maximum that has ever been recorded in this vicinity. The footing was increased 13½ ft. in depth and enlarged to 2½ times the area of the old footing. The safety factor against "cross-breaking" in the new foundation was stated to be 3.65. The accuracy of the computations is amply proved by the fact that the complete monument has stood safely for 50 years.

It is interesting to note that General Casey's committee made borings penetrating 18 ft. into the sand and gravel bed, which they found to be saturated up to 6 in. above the bottom of the footing. No reason is given in the record as to why the borings were not carried deeper. However, benchmarks were established at each corner of the monument, and quarterly readings have since been taken at each corner, except during the years 1904 to 1926. The record of the settlement is shown in Fig. 1, which has been arranged to show the various increases in loading during the construction of the monument. While it might be going too far to state that each increase in load caused a corresponding increase in settlement, it seems a remarkable coincidence that the settlement followed the loading so closely. Another curious feature about the monument is that, once having been plumbed, it has remained so for such a long period of time.

In 1901 the Senate Committee on the District of Columbia, of which Senator McMillan was chairman, prepared a comprehensive plan for Washington, which included among other things: the Union Station, the Lincoln Memorial, the Arlington Bridge and a plan for the Washington Monument Gardens. This plan, which is called the 1901 plan, contemplated a vast sunken garden surrounded by terraces just west of the monument, and a high-level terrace commencing at the monument and extending eastward to the Capitol. A tentative estimate of the amount of grading necessary to accomplish the 1901 plan shows on the east side of the monument a fill with a maximum depth of 25 ft. over an area of 1,400,000 sq. ft. west of 14th St.; between the monument and 17th St., an excavation with a maximum depth of 27 ft. over an area of 600,000 sq. ft., together with a fill contained within high retaining walls to a maximum depth of 30 ft. over an area of 1,500,000 sq. ft.

Expressed as weights, the fill to the east of the monument would total about 500,000 tons, that to the west about 600,000 tons, and the excavation would amount to about 300,000 tons, making a total shift of some 1,400,000 tons of earth.

Fig. 1—In 50 years the Washington Monument has settled about 5¾ in. The profile indicates how the greatest settlement occurred as the monument's weight was increased during the construction period but also shows that this settlement is continuing.



In view of the very substantial unbalancing of weights involved, it was felt that the entire situation should be carefully looked into before initiating such extreme changes so close to the base of the monument, and in 1930 Congress authorized Lieut.-Col. U. S. Grant, 3rd, to appoint an advisory committee of engineers and architects to study the matter. The engineer members of this committee were J. Vipond Davies and Lazarus White, of New York City, and John L. Nagle and the writer, of Washington, D. C.

The committee met early in 1931 and reviewed the incomprehensive mass of engineering data pertaining to the monument that had previously been collected. Practically nothing was definitely known as to what was underneath the footings. The record of the straightening of the monument and its subsequent settlement without tilting seemed to be an indication of soft ground underlying the sand and gravel bed, and before initiating any steps toward the preparation of detailed plans for altering the surroundings, a set of borings was ordered. This gave the results shown in Fig. 2, disclosing the existence and the extent of the suspected soft-clay stratum.

The significant point is that the blue clay is thickest under the north corners of the monument, and that this is where the greatest loading would occur under the 1901 plan. The original records state: "It has been observed during construction of this work that when any motion took place in the structure, due to addition of weight, the two north corners of the monument were the first to settle."

The 1931 report states that: "What is called blue clay on this log is in every respect similar to the beds of clay which underlie Lincoln Memorial and which caused considerable trouble with the foundations of the Memorial. . . . The material is also of the same character and consistency as the material known as Hudson River silt . . . It appears that in ancient days the main channel of the Potomac River was probably nearer the Virginia side than at present; that the entire area extending from west of the Lincoln Memorial over the low lands fronting on the Potomac River, including Potomac Park, the Washington Channel and extending southward to the Anacostia River, constituted a bay in which, for long periods, mud brought down by the Potomac River was deposited in horizontal beds. At a later date the river probably changed its course and eroded large portions of the mud so deposited, and re-deposited sands and gravels.

"The various sands and gravels lying under the monument site would be suitable and good foundation if such sands and gravels extended completely to bedrock with no intervening beds of clay, but with a clay bed underlying these sands and gravels a very treacherous foundation is provided, upon which it is not safe to unbalance the loading Further, the deposit of clay or silt overlying the rock in the vicinity of the Washington Monument is in such moist and soft condition as to be liable to flow under any considerable shifting of its superimposed load, this superimposed load being that of the monument itself, the fill surrounding the monument, and the natural deposits of sand, gravel, etc., immediately overlying it. In other words, this deposit is in such a condition that the shifting of the superimposed load may cause 'mud waves.' Only a slight 'mud wave' of this material would be sufficient to tilt the crust on which the monument is supported and very seriously endanger its stability. . . . To maintain the monument in its present condition, no underpinning is necessary, but underpinning would be necessary in order to carry into effect the . . . plan." The plan mentioned is the 1901 plan, of which a partial profile is shown in the dashed line in Fig. 2.

In brief, the conclusion seems to be that while the monument is stable if the existing foundations are not disturbed, it is impossible to set any specific limits to changes that could be made with safety, and therefore under present circumstances it seems that the less done the better, unless the foundation of the monument is carried down to bedrock. As a corollary conclusion it might be said that if the monument foundation *must* be carried to bedrock, discretion might have the better part of valor (and also costs might be reduced) by dismantling the monument and reconstructing it on a new foundation rather than to attempt to underpin it as it now stands.

As to the superstructure of the monument, the spalling of the exterior marble up to the 150-ft. level has always aroused great interest on the part of the public. Many theories have been advanced as to the cause, and periodically someone offers a solution. This matter was considered at length by the 1931 committee, and the general consensus of opinion was that there is at most only a very remote connection between the foundation conditions and the spalling of the superstructure. As the rate of spalling has been slacking off of late years and is now almost nil, the subject seems to be mostly of academic interest.

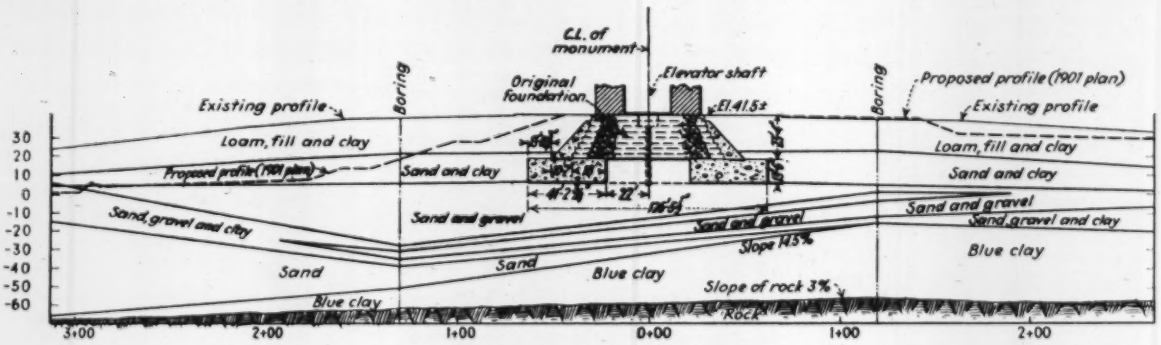


Fig. 2—The monument, although founded on sand and gravel, has experienced settlement because of a layer of soft clay present between the sand and gravel and the rock. The dotted line shows the proposed profile contemplated by the landscaping scheme of 1901. Present studies show that this profile cannot be safely realized because of the extensive shifting of weight on the blue clay that would result from the cutting and filling operations. The section is taken on the east-west axis of the monument.

Plan Standard Spike Spacings for Railway Ties

Increasing requirements for the boring of spike holes in ties before the ties are treated by preservative processes are causing trouble in the tie industry, owing to the extreme variations in the spacing of spikes for different railroads, different weights of rails and different forms of tie plates. It thus becomes impracticable to bore and treat ties in quantities for stock. To study the possibility of adopting a series of standard spacings for spikes as a remedy for the present situation, a special committee has been appointed by the Railway Tie Association. This committee is composed of W. J. Burton, assistant to chief engineer, Missouri Pacific Railroad; W. H. Penfield, engineer of maintenance of way, Chicago, Milwaukee, St. Paul & Pacific Railroad; and E. Kelly, of the Greenlee Brothers Co., manufacturers of tie boring and adzing machinery.

Construction Volume—
Is it a Forecast of General Business?

By Thomas F. McSweeney
Department of Building Construction, Massachusetts Institute of Technology, Cambridge, Mass.

IN THE 1930 "Review of Economic Statistics," W. C. Clark, statistician for S. W. Straus & Company, looked back over the happy days of the nineteen-twenties and made the following prediction: "When the economist of the future compiles the business annals of the past decade, he will find the key to our prolonged and unprecedented prosperity in the stimulus provided by two great industries—building construction and automobile manufacturing." If Mr. Clark, or any other commentator, were to make a similar prediction today, he would undoubtedly decide that the economist of the future, compiling the annals of the early nineteen-thirties, will find that the key to our prolonged and unprecedented depression is undoubtedly to be found largely in the collapse of the construction industry. Everybody whose livelihood comes from construction knows that when the building business is good everything else prospers, and that general business cannot possibly be in a healthy condition if building stops. It is the purpose of this report to make this more or less vague impression quantitative, and to suggest a measure of the relationship between construction and general business.

There are two general types of data available for a study of this sort, and both have been used in the statistical analyses prepared by the Department of Building Engineering and Construction at the Massachusetts Institute of Technology. One is the tabulation of permits issued in selected cities; the other is the data on contracts awarded. Permit figures are valuable largely because they can be extended backward for a great many years, and properly interpreted they form the basis of studies of long-time trends. The best work in this field is being done by John R. Riggleman, of the division of building and housing, Department of Commerce, whose preliminary report was summarized in *Engineering News-Record*, Nov. 10, 1932, p. 567. But for other purposes permit figures are apt to be dangerous. John M. Gries, head of the division of building and housing, in discussing permit figures, says, "Building permits as now used have several weak spots. At the present time there are many prominent private agencies which report monthly value of building permits issued in a large number of cities. Comparisons of these reports often reveal wide differences in values for a city, ranging at times to more than 30 per cent. In some cases different values have been reported for a given city by each of four agencies . . . Another weakness in permit figures is that the valuation is not made on the 100 per cent basis. The cost or fee for a permit as a rule is based on the estimated cost of the building. It is possible to place the valuation on as low as 60 per cent of actual cost. . . ."

The result of our analysis of permit figures confirms Mr. Gries.

Accurate and reliable figures on contracts awarded are available both from the Dodge Statistical Research Service, and from the index of construction volume, published each month by *Engineering News-Record*. Because of the nature of the contracts included in the *ENR* index, the curves resulting from its statistical analysis present some extremely interesting and perhaps significant features, not shown by any of the others.

The *Engineering News-Record* volume index number is the dollar value of contracts for heavy engineering types of construction reduced to the basis of 1913 = 100 in both volume and cost. It is compiled monthly by dividing the weekly average of contracts reported for the month by the current *ENR* construction cost index to reduce the value of contracts to the 1913 dollar, which figure is divided by the weekly average of contracts let in 1913 ($11,600,000) to obtain an expression of percentage of current work as compared with 1913. It is, therefore, a deflated index of construction in terms of the purchasing power of the 1913 dollar, and expressed as a per cent of the 1913 volume.

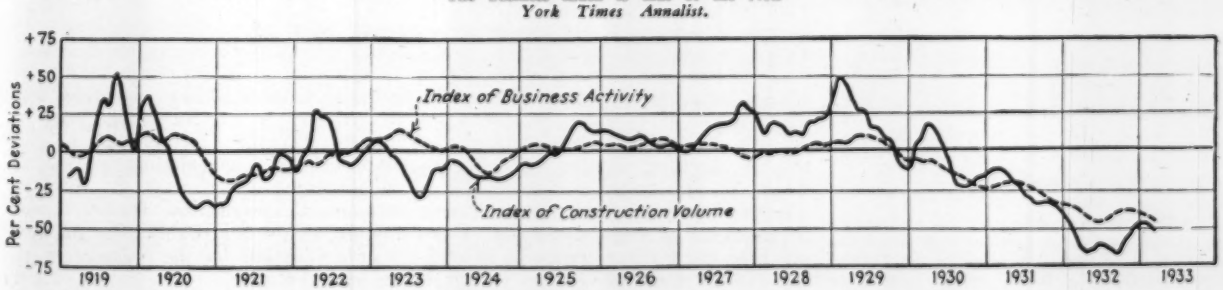
These index-numbers were corrected for secular trend by computing a least-square straight-line normal for the years 1919 to 1931 inclusive, and for seasonal variation by the method of ratio of actual to trend, and averaging the three median values thus obtained. These seasonal figures were also checked by computing link relatives of the monthly data. The monthly deviation figures obtained by this method were plotted as a time series to show fluctuations above and below trend for the period taken. When these figures were plotted they showed an erratic month-to-month variation; and to reduce these meaningless extremes, a three-months' moving average has been computed and used as the construction index shown on the accompanying chart.

To compare the fluctuations of the construction index to general business, the index of business activity of the *New York Times Annalist* is plotted on the same chart. This curve is a composite of ten indices, weighed as follows:

	Per Cent
Pig-iron production	10
Steel-ingot production	15
Freight-car loadings	20
Electric-power production	10
Cotton consumption	15
Wool consumption	7
Automobile production	10
Bituminous-coal production	5
Boot and shoe production	5
Zinc production	3

It is evident that the curve resulting from this combination is not independent of the Construction Index, as many of the component parts, particularly the first three, enter directly into construction. But even though this connection exists, the independence is great enough to make a comparison interesting, if not indicative.

The most striking feature of the comparison between the two curves is the way that the construction index always precedes the index of business activity. The depression of 1921 was predicted by construction early in the summer of 1920, and the recovery of 1922 was indicated by the pick-up of construction a year previously. The short, but sharp, business depression of



Trends in construction volume precede similar trends in general business according to this chart. The index of construction volume shown here is the author's "Course XVII Index" based on the volume index of *Engineering News-Record* corrected for seasonal and secular trend. The business index is that of the *New York Times Annalist*.

1924 was forecast in the early fall of 1923, and the milder recession of 1927 followed ten months after the similar drop in the construction index. The business collapse of October, 1929, was preceded by a collapse of construction in the early spring, and each of the numerous heart-breaking ups and downs of the business curve since then was indicated by a similar fluctuation of construction.

Five years ago a correlation like this would probably have been accepted as a means of forecasting business. But the trade of business forecasting has lost in prestige since 1929, and any predictions based on the movement of the construction index are to be made very cautiously, if at all. But when we realize that normally construction is responsible for one-eighth of the nation's income, it is not difficult to believe that the variations of this great item are bound to have a marked effect on everything else. And as the payments for construction lag several months after the award of the contract, it is clear that the effect of construction is not felt by general business for some time afterwards.

The *Engineering News - Record* figures are particularly useful for a business barometer of this sort, as they are limited to larger contracts. They not only foretell the influence that large construction programs have on business, but they indicate the expectations of exactly those men who should be best qualified to judge the future. They are the executives of larger corporations and those who control the financing of major construction programs. If they believe that business is to be better, they will build. If they are pessimistic as to the future, construction will stop. For these two reasons it is to be expected that the construction index might be an excellent barometer of business.

Measuring Earthquake Intensity in Pounds Per Square Foot

A suggested deduction based on a controlling maximum ground velocity for all periods in a given disturbance

By H. M. Westergaard
Professor of Theoretical and Applied Mechanics, University of Illinois, Urbana, Ill.

A CONVENTIONAL measure of the intensity of an earthquake is the ratio, α, of the greatest horizontal acceleration of the ground to the acceleration due to gravity. When seismograms are interpreted as sets of sine and cosine waves with different periods, superimposed on one another, it appears that the greatest values of the intensity α are identified with small waves with short periods, while waves with greater amplitudes and longer periods correspond to smaller intensities. The effects of an earthquake on a structure depend to a great extent on the relations of its periods of free vibrations to the periods of the vibrations of the ground. Therefore, if the safety of a structure against earthquakes is examined with due consideration of the different possible periods of vibration, it does not seem rational to assume a single constant value of the intensity ratio, independent of the periods. When the ratio is not a constant it loses its usefulness as a measure of the intensity of the earthquake, although of course it may be kept as a quantity occurring in the computations.

Consider the motion defined by the equation

$$x = \alpha g \left(\frac{T}{2\pi}\right)^2 \cos \frac{2\pi t}{T} \qquad (1)$$

in which x = the displacement of the ground in a horizontal direction, T = the period, and t = time. The maximum acceleration is seen to be αg. The maximum velocity becomes

$$v = \alpha g \frac{T}{2\pi} \qquad (2)$$

If α is to decrease when T increases, then perhaps it is plausible to assume α inversely proportional to T within some range of values of T. Then v becomes a constant. For this reason it is suggested that consideration be given to the following possibility: The anticipation of earthquakes in a given region is expressed not in terms of a greatest acceleration αg, but in terms of a greatest velocity v. The examination of the safety of a structure against earthquakes resolves itself, then, into a study of its vibrations due to the most unfavorable possible combinations of seismic waves, these combinations being subject to the restriction that the greatest velocity of the ground shall be v.

In case of simple harmonic motions, if in some region the ratio $\alpha = 0.05$ is likely to occur when $T = 1$ sec., then to $T = 0.1$ sec. would correspond $\alpha = 0.5$. The corresponding maximum velocity would be $v = 0.256$ ft.-sec.$^{-1}$.

Anticipating a particular maximum velocity of the ground is equivalent to anticipating a particular maximum kinetic energy of the ground per unit of volume. If w is the weight of the bedrock per unit of volume, then this kinetic energy becomes

$$k = \frac{1}{2} \frac{w}{g} v^2 \qquad (3)$$

This energy is measurable in ft.-lb. per cu.ft. or in lb. per sq.ft.

During an earthquake, waves of kinetic energy are transmitted through the bedrock. It seems reasonable that the intensity of this action should be measured by its energy. The suggestion is submitted that the energy k might serve as a measure of the intensity of earthquakes.

A numerical example will indicate the orders of magnitude of the various quantities. Assume $k = 1$ lb.ft.$^{-2}$, $w = 170$ lb.ft..$^{-3}$; then eq. (3) gives $v = 0.615$ ft.sec.$^{-1}$. If the motion is simple harmonic, eq. (2) gives $\alpha T = 0.12$ sec., which permits the combination $\alpha = 0.1$, $T = 1.2$ sec., $x_{max} = 0.118$ ft.

Letters to the Editor

Trends in Engineering Education

Sir—I am quite in agreement with the analysis of the future trends of engineering education made by Dean H. S. Rogers in your issue of April 6, 1933, p. 438. The tendencies that he outlines have been growing steadily for the past quarter of a century. In the nature of things any marked technological progress can come only through more highly trained men, for as progress is made in any line of thought the difficulties become increasingly greater, and the pioneer days of engineering are past. There is sure to be a demand for a limited number of highly trained men in all fields of engineering and a decreasing demand for engineers of ordinary ability and qualifications. I agree, also, with Dean R. A. Seaton that no revolutionary changes are necessary and that all educational thought is and should be always in flux to meet changing industrial conditions.

I am sure that Dean Rogers is quite right, also, in his opinion that there will be an increasing demand for engineers with administrative ability and sound training in business fundamentals. Industry in all of its phases has been growing more and more scientific, and in time there will be little or no place in industry for the executive of the old empirical type. An engineering course supplemented by courses in English, economics, corporation finance, cost-finding, etc., will probably offer the best training possible for the prospective industrial executive.

For best results such a course requires five years of college work. In the case of the limited number of more highly trained technical men five years is practically essential. But for the average man five years of college is not as yet a possibility for financial reasons alone. If the colleges are to prepare men for the field of industrial administration, some concessions must be made in the four-year courses.

At Cornell University, at least the tendencies that Dean Rogers outlines have been in operation for some time, and particularly in the School of Mechanical Engineering, which normally might be expected to prepare men for managerial positions. A definite program is well under way, looking toward higher scientific training for the smaller number of technicians and a broader training for the larger number of men who most naturally will find their place in life in administrative work. For these latter a new course, leading to the degree of Bachelor of Science in Administrative Engineering, was recently established and has met so far with marked success. This course, which is of the standard four-year type, consists roughly of 60 per cent engineering and 40 per cent of economics, accounting, money and banking, corporation finance, industrial relations, English, public speaking, marketing, etc. These more liberal subjects are not *superimposed* upon the engineering instruction, nor do they *precede* it as in many of the efforts that have been made to solve this problem. The first year is common with all other courses in the school and is naturally, therefore, almost wholly scientific. The engineering work based upon the first year tapers toward the senior year, while the liberal subjects, starting with nine university hours of instruction in the second year, broadens to 26 hours in the senior year. It is believed that this plan not only economizes time but also makes possible a better coordination of the work.

Cornell University,
Ithaca, N. Y.,
April 11, 1933.

D. S. KIMBALL.

College Reorientation Should Be Approached Cautiously

Sir—The articles "Reappraising the Work and Methods of the Engineering College" (*ENR*, April 6, 1933, p. 438), are worth careful study.

Both articles mention an obvious trend in engineering education toward broadening and simplification of the undergraduate program and increasing emphasis upon graduate work. They speak of the desirability and probability of a still further broadening of the undergraduate program and leave the inference that, with fewer technical positions to be filled, the engineering schools should plan their programs to fit graduates for whatever occupations they may find.

I think this trend involves a danger that is serious enough to warrant consideration. Unless we proceed carefully we may be in the position of attempting to develop graduate work of a distinctly scientific and professional type on the basis of an inadequate scientific and technical foundation. We may be in danger of doing precisely the same thing that the secondary schools have done in so broadening and liberalizing their courses as to furnish inadequate preparation for the professional and semi-professional collegiate courses.

A rapid growth of graduate work in engineering is evolution in the right direction, I firmly believe. The tendency is to make this post-graduate work much more scientific and specialized in its nature than undergraduate work in engineering. If my fears have any foundation, this may lead to a condition where our undergraduates are so inadequately prepared in mathematics and physical science that they cannot profit by the advanced work.

H. P. HAMMOND.

Brooklyn Polytechnic Institute,
Brooklyn, N. Y.,
April 12, 1933.

Education Rather Than Training for Engineering Students

Sir—Engineering education is suffering under the depression partly because it has been predicated more on the specified needs of industrial personnel than upon the aptitudes and personal qualities of the students. Regardless of what latent capacities students have possessed, engineering colleges have been too much disposed to mold them into certain industrial patterns, either furnished by instructors transferring from industry to the class room or by other contacts. To that extent, the colleges have done a disservice both to the students and to industry. How much talent not usable in these molds has been wasted there is no knowing, but the waste may have equaled the use.

Now when the procession through college halls, down the trodden road and into the gates of industry is blocked to a standstill, the question as to whether the better part of the student's talent was developed or thrown on the scrap pile is forced to our attention. Had the diversified faculties of students been used as the point of departure in the educational process, it is probable that there would now be fewer engineers with stifled imaginations left helpless while detached from a company payroll. Engineering education of the future will offer greater versatility, flexibility and convertibility for both men and industry in times of a depression if based less on the supposed needs of industry and more upon the discovery and recognition of individuality in students.

Broadening, or making the curriculum more diffuse, will not yield adaptability. Broadening is a vague phrase because its significance is relative. A general course in mechanical engineering today seems broad relative to that field when it does not specialize in any of its dozen major divisions, notwithstanding that when the cry first went up for broadened curricula, the same mechanical engineering course seemed highly specialized relative to the whole scope of engineering. Power for analytical and creative thinking, the primary objective, is more likely to result from an integrated course with logical sequences and proper standards than from superficial familiarity with a more scattered range of subjects. An intelligent man will acquire breadth after college, if at all, while a student passes but once along the time of this plastic development when his mental habits are forming. In this optimum time of educability, his mental fiber should be developed and disciplined rather than fattened.

Graduate study, which has come upon engineering colleges with a rush, offers fertile opportunity for the further development of individual proclivities that undergraduate study should have disclosed. The technical engineers of the future will largely be revealed by their attainments in graduate study and research within college walls rather than by the first year's performance at the works, and personnel methods will doubtless be modified to take advantage of this situation. In graduate study we may expect to find that the depression has compelled the solution of the long acknowledged problem for which various schemes for lengthened curriculum have been proposed. It offers the opportunity for the best contribution that college can make to industry and, at the same time, the acme of individual development for the student.

Educating the student instead of *training an engineer* will therefore receive renewed emphasis in the post-depression era of engineering education.

C. C. WILLIAMS.

State University of Iowa,
Iowa City, April 11, 1933.

Correction—Suspension-Bridge Sizes

In the article entitled "Cable Strength As a Measure of Suspension-Bridge Size," appearing in the March 16, 1933, issue, p. 349, there are three errors in the table. For the Mid-Hudson Bridge the cable length between anchorages is 3,287 ft. instead of 3,278, and the strength per cable is 19,500 tons instead of 14,500 tons. For the Manhattan Bridge the strength per cable is 28,300 tons instead of 33,300 tons. These corrections do not affect the relative positions of the bridges, as shown in the diagrams. In fact, the correct values are given in the diagrams, the errors appearing only in the table.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

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Uses of Hydraulic Machinery

HYDRAULIC MACHINERY—By Daniel W. Mead. Cloth 6x9 in.; pp. 396; diagrams and tables. Published by McGraw-Hill Book Co. Inc., New York and London. $4.

Hydraulic machinery, in this book, is considered from the point of view of the average engineer whose problem is not the design of the machinery but its most efficient use. The designing of pumps, turbines, water wheels, hydraulic jacks and rams is a matter for a specialist; here the author attempts to set forth the information needed by the general practitioner faced with the problem of what type of pump or turbine will meet the requirements of the job he has undertaken. The author also presents studies of the various methods of generating, transmitting and utilizing power both by hydraulic and other available means as a basis for selecting which type is best suited to the problem in hand. For this purpose three chapters are devoted to detailed analysis of energy losses, losses in various machines and appurtenances and to power and transmission systems. Hydraulic turbines are not discussed in detail as they are treated in the author's book on water power. In this book, in addition to general chapters, there are chapters on direct lift or bucket-lift pumps, reciprocating, centrifugal and air-lift pumps, the use of steam for pumping, the siphon and the hydraulic ram.

* * *

Arc-Welding Prize Papers

DESIGNING FOR ARC WELDING—Second Lincoln Electric Arc Welding Prize Papers. Edited by A. F. Davis. Paper; 6x9 in.; pp. 415; photographs, line drawings and tables. Published by the Lincoln Electric Co., Cleveland, Ohio. $2.50.

About twenty of the prize-winning papers in the second arc-welding competition conducted by the Lincoln Electric Co., of Cleveland, Ohio, have been assembled in book form. Descriptions of designs of arc-welded machines, structures and buildings were eligible, and the published book reflects these various interests, presenting five papers on machinery, two on ships, five on buildings, bridges and houses, three on large containers such as tanks and railway cars and three on pipe and fittings. In the structural-welding section the papers are on (1) the application of arc-welding to the design of steel buildings for the resistance of earthquake forces; (2) strengthening of weak iron and steel bridges; (3) the arc-welded steel-frame house; (4) welded steel floors; and (5) an arc-welded steel floor adapted to residence construction. An abstract of the first paper, which was concerned with the design of the thirteen-story Southern California Edison Building in Los Angeles, was published in *Engineering News-Record*, Sept. 15, 1932, p. 312. According to reports, the building was not damaged in the recent earthquake of March 10.

* * *

Exploring the Colorado Canyons

COLORADO RIVER CONTROVERSIES—By Robert Brewster Stanton; Edited by James M. Chalfant. Cloth; 6x9 in.; pp. 232; photographic illustrations. Published by Dodd, Mead & Co., New York. $3.00.

Stirring events of more than sixty years ago are the raw material of Stanton's posthumous book on the Colorado River, and these make it interesting reading, though the substance that he presents has only historical value. Stanton's position as perhaps the first real explorer of the river—he went down through the full length of the canyons in 1889-90 on a railroad reconnaissance, as chief engineer of the Denver, Colorado Canyon & Pacific Ry.—lends technical interest to his writing and authority to his statements. But the two questions which he discussed in a hundred pages each, the alleged voyage of James White through the canyons on a raft in 1867, and Major John W. Powell's truthfulness as to his boat journeys of 1869 and 1872 and his relation to the three men who left his first expedition before completion, are rather unsubstantial stuff out of which to make a romance of the Colorado's stupendous gorges.

* * *

Stream Sanitation

TRANSACTIONS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS 1931. Cloth; 6x9 in.; pp. 410; photographs, tables and line cuts. Published by D. Van Nostrand Co., Inc., New York City.

Seven papers on matters relating to stream sanitation make up the first 122 pages of the 1931 Transactions of the American Institute of Chemical Engineers, recently published. They are: The Use, Not the Abuse of Streams, Sanitary Conservation of Streams by Cooperation, Stream Pollution in the State of New Jersey, Administrative Control of Water Pollution, Work of the Connecticut State Water Commission, Disposal of Waste Formed in the Manufacture of Starch and Beet Sugar, and Liquid Waste From Industrial Plants and Their Treatment. These papers, by men prominent in the sanitary engineering field, were presented at the Atlantic City meeting of the society in December 1931.

Structural Welding

ARC-WELDED STEEL-FRAME STRUCTURES—By Gilbert D. Fish. Cloth; 6x9 in.; pp. 401; photographs, tables and line drawings. Published by McGraw-Hill Book Co., Inc., New York and London. $5.

PUBLICATION of the first book on structural welding is an event of importance. In a measure it signalizes the end of the pioneer period during which the art of fusion welding was being adapted to the needs of the structural engineer by laboratory studies and by the collection of field experiences and service data. During this period, structural welding has necessarily been a field for specialists. These specialists have contributed freely of their knowledge to technical societies and the technical press so that the literature of structural welding is already voluminous. A text book summarizing and codifying this literature for the designer and the builder was the next logical step. And it was needed badly to assist in changing structural welding from a specialty field to one in which the whole profession could operate.

Mr. Fish's book should fill this need admirably. Its subject is arc-welded construction rather than the arc-welding process. It is written for the practicing engineer. The first four chapters review existing welded structures, describe the arc-welding process, classify weld forms, define welding terms, give data on physical properties of welds, outline methods of stress analysis and present specifications covering design and workmanship. This part of the book constitutes the introduction to a most valuable group of chapters covering joint design, economy, construction methods, estimating, shop drawings and supervision. In the chapter on the design of arc-welded connections is a group of seventeen tables giving allowable loads on various types of welds and joints.

The author devotes the concluding chapter to a review of some of his conclusions regarding economy and safety of welded construction, drawn from his wide experience in design and supervision. The Sharon Building is used to illustrate methods of designing for continuity. The two-acre shop building at Derry, Pa. illustrates how steel may be fabricated at the building site for certain types of structures. The Chicopee Falls bridge is used to illustrate the principles of designing for impact stresses. The trolley bridge at Bound Brook, N. J. illustrates methods of bridge strengthen-

ing and repair under traffic. Large office buildings are included, in which some standardization of connections is possible. Hospital additions exemplify the advantages of welding where noise elimination is a factor. The Yale dormitory buildings are used to illustrate a type of structure in which separate shop drawings were required for almost every connection. Thus the last chapter is an abstract of experience as it exists today. Wide application of the data in the book, should greatly extend this experience in the next few years.

Chemistry of Cements

Reviewed by P. H. Bates

Chief, Clay and Silicate Products Division, Bureau of Standard, Washington, D. C.

CHEMIE DER ZEMENTE—By Karl E. Dorsch. Paper; 7x10 in.; pp. 277; tables and line drawings. Published by Julius Springer, Berlin. 23.50 R.M.

THIS VOLUME by Dr. Karl E. Dorsch is an excellent compilation of the modern and most generally accepted views concerning both the chemistry of the making and the hardening of hydraulic cements. To make the volume more valuable to those who have not been able to familiarize themselves with basic theories, the author very tersely but just as adequately reviews these. He quite properly does not go into the details of plant production methods or details of the use of testing cement, nor to a major degree into the relation of the chemical and physical properties of cements. His not having done so is to be highly commended. Such discussions would not properly come under his chosen title and would only detract unnecessarily from his orderly presentation of the subject. The book is also valuable to those who desire to know something regarding the nature of the many various hydraulic cements recognized in Germany. Included in these classes by the author are non-clinkered cements (hydraulic limes and natural cements), portland cements (ordinary portland, high-strength portland, and highest-strength portland), siliceous admixed cements (high percentages of blast-furnace slag or Hochofen cement, low percentages of blast-furnace slag or Eisen portland cement, puzzolana and trass), slag cements and fused high-alumina cements.

Miscellaneous Notes on Booklets and Reprints

INDUSTRIAL USES FOR SMALL-DIMENSIONED STOCK is the subject of a pamphlet published by the National Committee on Wood Utilization. Copies may be obtained from the Superintendent of Documents, Washington, D. C., for 5c.

WELDING WITH MANUFACTURED, NATURAL AND MIXED GAS is the subject of Research Series No. 41, Engineering Experiment Station, Purdue University, Lafayette, Ind. The investigation covered by the report was made at the Experiment Station and was sponsored by the Utilities Research Commission, Inc., of Chicago. Price 10c.

THE SHIFT OF STORM TRACKS on the 11-year solar period is the subject of Publication 3188 of the Smithsonian Miscellaneous Collections, Vol. 89, No. 2. Storm frequency maps for the United States, 1883-1830 also are included. The Smithsonian Institution, Washington, D. C.

THE AUTOMOBILE'S CHALLENGE to America's transportation policy was discussed by B. E. Hutchinson, vice-president, Chrysler Corporation, in the Cyrus Fogg-Brackett lectureship in applied engineering and technology of the School of Engineering, Princeton University, Princeton, N. J. The lecture has been printed in pamphlet form by the School of Engineering.

PAPERS OF THE WATER AND SEWERAGE CONFERENCE held last October in Missouri have been made available in a 76-p. report covering eight papers on water purification, six on operation and five on sewage treatment. Helps noted for the small operator include such topics as when and how to wash a filter, activated carbon and iron removal results, painting tanks and routine hydrant inspection. The booklet is a joint product of the conference and State Board of Health, Jefferson City, Mo.

A DISCUSSION OF FLOODS, begun some time ago by the Boston Society of Civil Engineers and published by the society through the generosity of the late John R. Freeman as "Report of the Committee on Floods of the Boston Society of Civil Engineers," is continued in a discussion published in the December, 1932, *Journal* of the society. The original report was published in the *Journal* for September, 1930. The journal sells for 50c. a copy and may be obtained from the society at 715 Tremont St., Boston, Mass.

IN LINE WITH THE ADVANCE PLANNING proposed in the Federal Employment Stabilization Act, a bulletin on advance planning of public works in the District of Columbia has been prepared by the Federal Employment Stabilization Board to meet an increased demand for a detailed explanation of the methods and technique employed in the District of Columbia for other cities to follow in establishing advance planning of public works. The bulletin is a 28-p., 9x11¼-in. pamphlet with a few maps, many charts and numerous tables. Some of the chapter headings are as follows: Development of Washington; Government of the District; Fiscal Affairs; Trends to Be Considered in Planning; Planning Public Works in the District; and Exhibits of Planning of the District. Copies may be obtained from the Superintendent of Documents, Washington, D. C., for 10c.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS GUIDE, 1933—6x9 in.; pp. 767; line drawings and tables. Published by The American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City. $5.

ANALYSIS AND DESIGN OF STEEL STRUCTURES—By Almon H. Fuller and Frank Kerekes. Cloth; 6x9 in.; pp. 451; photographs, tables and diagrams. Iowa State College Book Store, Ames, Iowa. $5.00.

BARRAGES ET GÉOLOGIE, By Maurice Lugeon. Cloth; 8x11 in.; pp. 158; photographs and line drawings. Published by Librairie de L'Universite, F. Rouge & Cie S. A., Lausanne, Switzerland.

BYGNINGSSTATISKE MEDDELELSER—Paper; 7x10 in.; pp. 14; line drawings. Published by I. Kommission Hos Jul. Gjellerups Boghandel, Kopenhagen, Denmark.

DER GRUNDEAU—By L. Brennecke and Erich Lohmeyer. Paper; 7x10 in.; pp. 80; photographs and line drawings. Published by Wilhelm Ernst & Sohn, Berlin, Germany. 5.70 RM.

THE GOVERNMENT OF THE METROPOLITAN REGION OF CHICAGO—by Charles E. Merriam, Spencer D. Parratt, Albert Lewpawsky. Paper; 5x8 in.; pp. 193; illustrations. Published by The University of Chicago Press, Chicago, Ill.

IRRIGATION PRACTICE AND ENGINEERING: Volume 1, Use of Irrigation Water and Irrigation Practice—By B. A. Etcheverry and S. T. Harding. Cloth; 6x9 in.; pp. 256; numerous charts, line drawings and halftones. Published by McGraw-Hill Book Co., New York and London. $2.50.

LOW-COST ROADS AND BRIDGES—By Victor J. Brown and Carleton N. Conner. Cloth; 6x9 in.; pp. 544; numerous charts, line drawings, halftones and tables. Published by Gillette Publishing Co., Chicago. $6.00.

MATERIALAUSWAHL FÜR BETONBAUTEN—By H. Vetter and E. Rissel. Paper; 5x8 in.; pp. 94; photographs, line drawings and tables. Published by Julius Springer, Berlin, Germany. 4.50 RM.

DIE METHODE DER PRIMÄREN MOMENTE—By Axel Efsen. Paper; 7x10 in.; pp. 141; tables and line drawings. Published by In Kommission Bei G.E.C. Gad, Kopenhagen, Denmark.

THE PORT OF NEW ORLEANS, LOUISIANA: Port Series No. 5, Revised, 1932. Paper; 6x9 in.; pp. 226; photographs, maps and tables. For sale by Superintendent of Documents, Washington, D. C. 40c.

STANDARDS YEARBOOK 1933—Compiled by The Bureau of Standards. Cloth; 6x9 in.; pp. 255; tables. Published by the Superintendent of Documents, Washington, D. C. $1.00.

TAXATION OF MOTOR VEHICLE TRANSPORTATION—By the staff and advisors of the National Industrial Conference Board. Cloth; 6x9 in.; pp. 196; many tables. Published by the National Industrial Conference Board, 247 Park Ave. New York, N. Y. $2.50.

Engineering News-Record

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A. Bowers, J. I. Ballard.

Editorial and Publishing Offices at 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, England.

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APRIL 20, 1933 Volume 110 Number 16

A Note of Moderation

IT IS estimated that 5,000 bills affecting motor-vehicle operation have been introduced in the 44 state legislatures in session since winter. This record surpasses that of railway regulation in the roaring nineties. Curiously enough, the farming states, which were the center of radicalism in railway legislation, have been the most conservative in respect to penalizing the motor vehicle; the most drastic of the new laws originated in the industrial states of the East. On the whole, however, legislatures have exhibited a creditable resistance against the attempt to stampede them. Only a fraction of the legislation asked for has been considered, and the few laws passed have shown a fairly even balance between tax reductions and tax increases. In general, the motor vehicle operator has come through the biennial legislative mill in 1933 in far better condition than he did in 1931, when about 7,000 bills came to the clerks' desks of our state legislatures and a score of states added to the imposts on motor-vehicle owners. Apparently the fact that diminishing returns follow excessive tax raising is filtering slowly into the thinking of our lawmakers.

Cross-Connections

ONCE MORE encouragement has been given to the elimination of cross-connections between good and bad drinking-water supplies. The American Water Works Association has approved an exhaustive committee report in which such elimination is recommended. In 1925 the fire-protection division of the association went on record against cross-connections, and a dozen states soon thereafter adopted stringent regulations. At present thirteen states prohibit cross-connections entirely, and nine permit them when they are properly "protected." Recently Los Angeles, which has long waged a fight against the practice, aided by an ordinance of several years' standing, obtained convictions and jail sentences of four fish dealers who were maintaining connections between city water and polluted bay-water supplies. It is to be hoped that many other states now will follow the lead given by the association. Experience with cross-connections is now wide enough to enable any state board to formulate regulations without any feeling that insufficient tests have been made. And the tests are conclusive that the danger of cross-connections is too serious to permit of taking chances with them.

Society Rackets

"ENGINEERING SOCIETIES" that have no excuse for existence other than to support the secretary continue to draw tribute from engineers. Within the past few days an engineer who was "elected" to such a society last April, having received notice of his dues for the year 1933 and having received nothing else from the organization, inquired of the editors of this journal as to the character and activities of the society. The society, so far as we can determine, serves no useful purpose; it is kept alive by engineers who, like this one, do not take the trouble to investigate when they receive a notice that they have been elected to membership without even having applied for membership. Engineers owe it to their profession as well as to themselves to withhold support from such parasite organizations, as well as from organizations that have atrophied to the point where they no longer serve a useful purpose. To permit the important field of society activity to become infested by rackets is sure to bring serious harm to the profession.

Competent Management

A NEW prospect opens up for the city of Chicago with the selection of Edward J. Kelly as mayor. So deeply has the city become mired in a financial and administrative morass that only the most competent management based on intensely practical recognition of fact is likely to lead it out in reasonable time. By selecting the chief engineer of the Sanitary District and the head of the South Park Board as its executive, the city has now provided itself with such management. Chicago's greatest problems are those which rest on an engineering foundation, problems similar to but greater than those of the Sanitary District and the Park Boards; prominent among them, next to financial rehabilitation, is the introduction of water filtration, a crying need. The new mayor brings to these problems an understanding of engineering projects developed in 40 years of continuous professional service, from rodman to chief engineer. In addition he possesses noteworthy ability to obtain teamwork. For many years, amid the turmoil of changing political administrations, he has stood staunchly for efficiency and continuity of service in his technical organization, and his efforts were rewarded by the steadfast loyalty of his staff. Chicago may confidently look forward to brighter days under its new mayor. His career gives assurance that in his new executive responsibilities he will uphold the best traditions of the profession which he has long served.

Tennessee Valley Power

LEGISLATION now before Congress providing for the generation of power on the Tennessee River and its tributaries as the first step in the Administration's scheme for coordinated development of the entire Tennessee drainage basin is in highly indefinite form. Moreover, the provisions of the Senate and House bills conflict too much to justify more than general deductions as to what form the legislation ultimately will take. Both bills authorize the construction of the Cove Creek dam on the Clinch River as a combined power and storage project, the addition of power-generating units in both the steam and hydro plants at Muscle Shoals, and the construction of a transmission line connecting the Cove Creek and Muscle Shoals plants. These are the only specific items of construction in the bills. Obviously they will not revolutionize power development in the Southeast nor destroy the equity of private individuals in the existing public utilities of the region, as has been charged. In their general terms the bills give the proposed Tennessee Valley Authority broad powers to issue

bonds, build steam and hydro-electric generating plants, and sell power "within transmitting distance"; but these powers are indefinite and of little use without large sums of real money back of them. Assuming that the government's scheme for the development of the whole river basin is to be carried forward, the amount of power to be produced by the specific proposals of the bill will be absorbed easily by new industries and increased use of electric energy in the valley. The present power-development legislation, therefore, warrants favorable consideration as a major element of the large future scheme—whose details undoubtedly will demand much fuller study before they have practical meaning.

Frame and Wall Resistance

CERTAIN phenomena observed among the effects of the Long Beach earthquake have instructive bearing on moot questions of building strength. They relate not to schools and minor buildings but to the major buildings of steel or concrete-frame construction. The facts which they reveal about wall action are not essentially new but stand out more clearly in the present instance than in prior ones; and because of the modern character of the structures involved they furnish specially strong confirmation of earlier observations and conclusions. They establish the fact that walls play an important part in determining the resistance of frame-and-wall buildings to either wind or earthquake attack.

Reports on the major buildings within the Long Beach earthquake zone agree in stating that no damage was done to their frames by the shock of March 10. The movement impressed upon the buildings did not stress their frame members and joints seriously, as the absence of distortion indicates, but did crack and shear apart many of the wall panels with which the frame openings were filled. It is apparent that the walls were in full action to oppose the lateral forces, while the framework was not heavily stressed.

It would appear that until the walls failed, they bore the chief burden of resisting the lateral forces. This conclusion is in harmony with what might be inferred from the nature of the building structure, a composite of a square meshwork of frame members combined with a continuous slab or diaphragm in the plane of the meshwork. The slab is by far the more rigid element in this composite in respect to lateral distortion of the building; and since load stresses travel along the paths of highest rigidity, the lateral forces are bound to develop principal resistance in the walls.

Current practice assumes that the walls are a mere skin that plays no part in resisting lateral forces. Many experiences show that this assumption does violence to the physical facts. In every serious earthquake the walls of framed buildings have been sheared, and at Long Beach it was noticed in some cases that the sides of wall panels had slipped along their bordering columns and girders. Again, in a high and slender building a gale recently caused certain tile-block partitions to shear or slip at floor or ceiling. And still further, the 1926 hurricane at Miami revealed the important participation of the walls in lateral resistance, by the loosening, shearing and destruction of walls and partitions in the Meyer-Kiser and Realty Board buildings.

All observations, in short, prove that the primary attack of lateral forces is on the wall elements, and that these elements supply the initial resistance to both wind and earthquake. At Tokyo and Miami the partial failure of framework after the walls had failed tended to obscure the controlling importance of the walls in respect to transverse strength. Yet the Japanese engineers recognized it clearly and recommended that reinforced walls and partitions be used liberally to provide strength against earthquakes. Present facts warrant general recognition of wall action as a factor in building strength, not only in earthquake regions but also in localities where wind alone is considered.

Neglect of wall resistance is uneconomical because it leads to waste of material in the framework. It is inefficient because it produces walls that are a danger rather than an element of strength. When their proper function is duly recognized, walls will be proportioned with adequate strength and thorough bonding to the frame, and buildings will be produced that are able to survive hurricane or earthquake unharmed, not merely as frames carrying the wreckage of shattered masonry. In those special cases where it is desired to use thin walls or where the building is to be made flexible rather than rigid, the altered function of the wall of course requires that it be able to adapt itself to the distortion of the frame without rupture, which may be accomplished by using slip joints. In either case, however, efficient design demands that wall action be thoroughly appreciated as a controlling factor.

Constructive Action In Sight

FORECASTS of constructive developments have come from Washington with authoritative force within the last few days. Reports predict that a broad plan for employment through a stimulated program of public-works construction will soon be put forward; and it appears certain that when this is done Congress will support the plan enthusiastically. Thus the long battle to initiate a national campaign on deflation by large-scale public construction appears to be nearing a successful outcome.

Events have shown that industry does not possess sufficient power of spontaneous recovery, and that the most heavily deflated industries, those which make producers' goods, are unable to resume until they receive new orders, although they do not lack working credit. Manufacture of consumers' goods, on the other hand, is limited by decreasing purchasing power. In view of these facts the conviction has finally established itself, as Senator Wagner said in a public address some days ago, that "the indispensable next step is the inauguration of a program of construction large enough to start the wheels of industry revolving once more. By no other method can we preserve the spiritual morale of our people and at the same time enlarge the permanent wealth of our nation."

But in the present prospect a further passage from Senator Wagner's address is of great significance: "Federal action alone is insufficient. In the last analysis, whether we shall recover and how fast we shall recover depends upon the faith and cooperation of the American people as a whole." The responsibility, plainly, rests individually upon each one—upon citizen, business man and official. When all these are fully imbued with the will to rebuild and with the spirit of new enterprise, the campaign to restore employment by resumption of public construction promises to bring about rapid regeneration of economic vigor.

NEWS OF THE WEEK

A Road Program of $350,000,000 Being Advocated

A ROAD PROGRAM calling for $350,000,000 of federal money has been proposed by the American Association of State Highway Officials. In a communication to all members of the Senate and of the House of Representatives the following proposals are made: Federal-aid for the fiscal year to end June 30, 1934, $100,000,000; federal-aid for the fiscal year to end June 30, 1935, $100,000,000; for bridges and for the elimination of railway grade crossings, $100,000,000; for secondary road construction under state supervision, $50,000,000.

It is suggested that a bond issue for a capital investment of this sort is sane procedure.

The association points out that last year road building supplied a living wage for more than 4,000,000 people. "This is not guess work. We handled the payrolls," says the association. In that connection it was pointed out that every mile of improved road reduced highway transportation costs and added to the permanent wealth of the nation. "This activity," says the association, "impoverished no one and the bill was paid by those who used the highways." Since the President has announced that there must be a public works program to aid in meeting the unemployment problem, the association urges that road building be put at the head of the list. Plans for these roads have been prepared so there would be no lost motion, it is pointed out.

Bids on Cement for Highways Again Rejected in Illinois

The State of Illinois, for the third consecutive time, has rejected bids on 3,300,000 barrels of cement for highway construction purposes. Rejection on April 14 was based on the refusal of the 16 companies to bid a price f.o.b. factory, as was required under the specification and proposal. Earlier bids were rejected on the ground that the 16 companies made almost exactly similar bids, averaging 68 cents higher than last year. Advertisement for new bids specified that prices be quoted f.o.b. factories, as well as at point of destination.

"This shocking and unanimous refusal of the companies to bid on the specifications of the state clearly shows collusion on the part of cement manufacturers," Governor Henry Horner said in a statement when rejecting bids. He requested the Department of Public Works and Buildings to consider the postponement of pavement construction requiring the use of cement until such time as the state can supply cement of its own manufacture, or meet the situation equally effectively.

An investigation of the cement price is before the state legislature.

Over $7,300,000 Bid on Tunnels for Colorado River Aqueduct

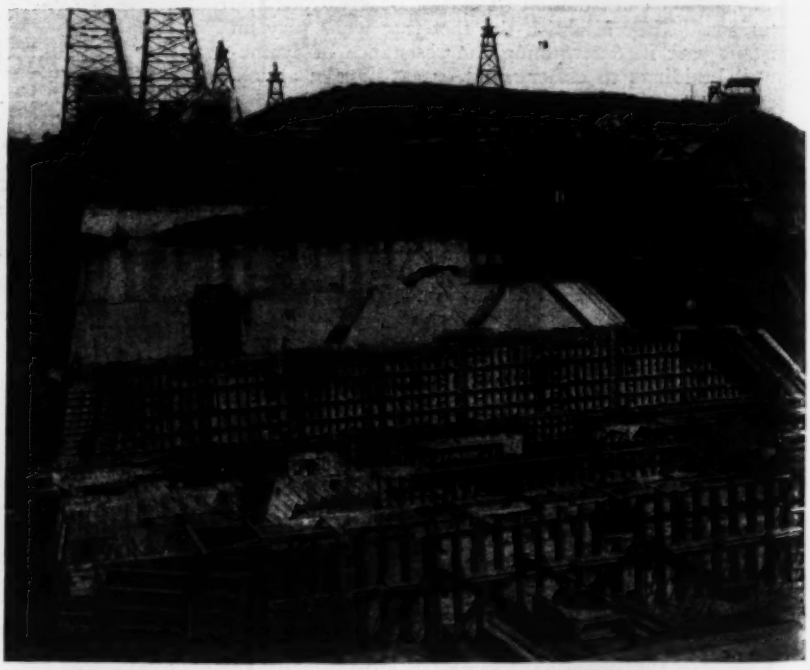
Bids totaling $7,324,680 were received by the Metropolitan Water District of Southern California on April 17 when bids on three tunnels of the Colorado River aqueduct were opened. Winston Brothers, Los Angeles, bid $2,143,799 on the 4.5-mile east portion of the Iron Mountain tunnel, and the Utah Construction Co., San Francisco, bid $1,699,705 on the 3.1-mile west portion. Winston Brothers bid $799,236 on the 1.6-mile east portion of the Coxcomb tunnel and $825,279 on the 1.6-mile west portion. On the Cottonwood tunnel the firm of J. F. Shea, Inc. Boulder City, Nev., bid $928,538 on the 1.9-mile east portion and $928,123 on the 1.9 mile west portion. These bids all were for tunnels of 16-ft. interior diameter. Bids also were called on tunnels of finished interior diameter of 12 ft. 4 in. but the larger size now is favored.

Large Contract for Highways Reported Let in Mexico

A contract for 31,000,000 pesos (about $10,000,000) has been awarded to Camilo Figueroa, prominent Mexican highway contractor, by the Ministry of Communications and Public Works, according to an unofficial but well substantiated report.

The contract calls for the completion of the trunk highway between Mexico City and Nuevo Laredo on the United States border, between Mexico City and Guadalajara, the capital of the state of Jalisco and the second largest city in Mexico, and between Mexico City and Acapulco, a resort on the Pacific Coast. The latter road has been in service for several years but needs much work to make it a first-class highway. Work on the other road is partly completed.

It is understood that Mr. Figueroa's bid was the lowest of three submitted, the



RODRIGUEZ DAM CONSTRUCTION RESUMED

Active construction operations on the Rodriguez dam, near Tijuana, Mexico, 25 miles south of San Diego, have been resumed after a shut-down of about eighteen months. Work is now being done by the Mexican federal government under the direction of the National Commission of Irrigation. Rehabilitation of plant and equipment was started in February and about 2,300 cu.yd. of concrete was placed during the first three weeks of March. At present about 300 men are employed working one shift per day and the factor of unemployment relief is one of the important considerations.

Present operations consist of raising the buttresses of this record breaking Ambursen type dam which will have a total height of 250 ft. The complicated foundation problems and their solution, including provision for taking care of a streambed fault were described in detail in *Engineering News-Record* of Oct. 16, 1930, p. 600. Manuel Rivas is director of the National Commission of Irrigation of Mexico and Adolfo Orive Alba is chief engineer. Francisco Gomez-Perez, who last September succeeded J. L. Favela as engineer in charge in behalf of the territory of Lower California, has rejoined the staff of the National Irrigation Commission at Mexico City and has been succeeded by J. Chavez Orozco as construction manager. Charles P. Williams is resident consulting engineer for the government and John L. Frazier remains as superintendent of construction for the contractor, the Ambursen Construction Co., New York.

others being by Warren Bros., Boston, and the Foundation Co., New York.

No cash is to be paid for work done during the present year. Starting Jan. 1, 1934, the government will pay 50 per cent in cash and 50 per cent in road bonds. All deferred payments will be made within five years of date of the issuance of the federal government bonds from gasoline taxes and other excise fees allocated to road work.

The contract calls for the completion of the work required on the highway to Nuevo Laredo and the highway from Mexico City to Acapulco by the end of 1935 and requires that both roads be put in serviceable condition by the end of the present year. Work on the Mexico City-Guadalajara highway is to be completed by the end of 1936.

Young Men Preferred for Forest Conservation Work

Chiefly young men are being picked for forest work under the Administration's emergency conservation program, according to an announcement by Robert Fechner, director, Emergency Conservation Work, Washington, D. C.

"Young, unmarried men have had the greatest difficulty in recent years in securing either work or relief. Therefore, in the first selections of people for this work, we will make the work available for unemployed, unmarried men, 18 to 25 years of age, who desire to allot a substantial part of their cash allowance for the benefit of their families and dependents. Many of these men have been unable to secure any chance for self-support in the last four years and they are, moreover, the very men who are best adapted to the kind of work, and who are most likely to profit by the education and training which this opportunity will give them.

"In addition to this group of men, there will also be employed a relatively small number of unemployed men of suitable age and experience, residents in the area to be developed by the emergency conservation work, because these men are definitely useful in the project and peculiarly entitled to share its advantages.

"Each state will be assigned its equitable quota from the 250,000 persons selected to do this work. The Labor Department will consult with the state official having had the administration of unemployment relief in the respective states, and will arrange for the selection of men from the lists of applicants for work and for other assistance which already exist in every state in the Union. Until these already existing lists are exhausted, no further applications can be received anywhere.

"The work to be done in the different camp areas is relatively comparable throughout the region covered by the fifty sites already announced. It will consist of work on truck trails, trails and paths and fire breaks. The system of fire breaks will be more intensive on plantation areas and areas planted. Timber stand improvement will also be done. This work will consist of thinning over-stocked areas, and cutting or deadening old, defective or unmerchantable trees which retard the young growth. Planting operations in some forests also will be carried on. From many of the camps, timber survey work will be carried forward.

Edward J. Kelly Chicago Engineer Appointed Mayor

EDWARD J. KELLY, chief engineer of the Chicago Sanitary District, on April 13, was unanimously elected mayor of the city of Chicago by the city council to fill the unexpired term of the late Anton J. Cermak. The term expires April, 1935. Mr. Kelly, who was selected by the Democratic organization as the best man available to pull Chicago out of its financial muddle and be its World's Fair Mayor, has been

president of the South Park Commission since 1924. He has served the sanitary district for nearly 40 years, beginning in 1894 as axe man and coming up through the ranks as rodman, computer, head inspector, levelman, instrument man, assistant engineer, assistant chief engineer and finally chief engineer. He has led the district's litigation over regulation of the lake diversion in the main drainage channel and has supervised construction of the vast sewage treatment works to meet the decree of the Supreme Court.

As head of the South Park Commission he has had charge of construction of 70 miles of park boulevards, a $30,000,000 development undertaking, development of Grant Park, Chicago's front yard, Soldier Field Stadium, seating 100,000 people, and the $10,000,000 outer drive and bridge project connecting the Lincoln and South Park systems. He sponsored the restoration of the Fine Arts Building in Jackson Park, which has recently been completed at a cost of $5,000,000.

Mr. Kelly is a member of the American Society of Civil Engineers and Western Society of Engineers. Author of numerous pamphlets on the district's projects, he also has been a frequent contributor to *Engineering News-Record*. His work, although not under civil service, has been singularly noted for its high character.

Low Bid on Columbia Jetty Work

The firm of Guy F. Atkinson, Portland, Ore., was the low bidder on the repair and extension of the south jetty at the mouth of the Columbia river when bids were opened by the U. S. Government recently. The company bid $1,686,403.

Highway Use Limitation Upheld

The right of a state to limit the use of its highways has been upheld by the United States Supreme Court in a decision sustaining the Ohio State Public Utilities Commission in its denial of a permit to the Wolverine Motor Freight Line for permission to operate over Route 20 from Cleveland to the Ohio-Michigan state line. The state commission had refused a permit to the freight company on the ground that the highway was too congested but had offered the company a permit over a less-congested route.

The U. S. Supreme Court has held that such a denial of permit is a valid exercise by the state of its police power. The court refused to accept the theory that the decision was a restriction upon interstate commerce, pointing out that it did not prohibit the transportation of goods over other highways of the state.

Power Project Near Seattle Advanced for R.F.C. Loan

The city council of Seattle, Wash., has authorized J. D. Ross, superintendent of the city light department, to go to Washington to urge the approval of an R.F.C. loan for the construction of the Ruby power and flood control project on the Skagit River near the British Columbia-Washington boundary.

The project is the most northerly in the city's hydro-electric development program for the river and would involve in addition to the construction of the Ruby dam the clearing of 20,000 acres for a long reservoir extending into British Columbia. The work is estimated to require 5 years and to cost $18,500,000.

On April 26 the Board of Public Works will open bids for the completion of the Diablo plant on the Skagit river, as noted in the issue of April 13, p. 483.

Muskingum River Development Proposed as Relief Measure

Flood control in the Muskingum River valley in Ohio along with the checking of soil erosion and reforestation of marginal land similar to the work now proposed for the Tennessee River basin has been proposed to President Roosevelt for inclusion in a large program of public works. Because of the existence of the Ohio Conservancy law under which the well-known work in the Miami River valley was carried out several years ago, work on the Muskingum can be gotten under way in a very short time. The proposed work in the Muskingum valley includes the construction of several large reservoirs and a number of smaller ones, some with permanent lakes in the lower portion, development of forest and park areas, soil erosion prevention work, local channel improvements and various incidental conservation and flow regulation work. The valley has a drainage area of 8,038 square miles, one-fifth of the entire state and 23 per cent of the Ohio river watershed above Marietta. Preliminary plans for a conservancy district were made by the Morgan Engineering Co. several years ago and more recently the state made an investigation of the entire watershed.

Edward E. Wall Reappointed Utility Director at St. Louis

Edward E. Wall, consulting engineer, St. Louis, has been reappointed director of public utilities of St. Louis, Mo., by the newly-elected mayor. Seven years ago, following a farcical trial in which the then mayor of the city failed in his attempt to sustain charges of incompetency against Mr. Wall, the mayor dismissed him upon his refusal to resign.

Commenting upon the reappointment of Mr. Wall, the St. Louis *Post-Dispatch* said, "Mayor Dickmann has restored Edward E. Wall to the post of director of public utilities, from which Mr. Wall was dismissed in 1926. In so doing the mayor has gained a measure of public confidence. He has gained it by undoing something which caused his predecessor to lose it. Mr. Wall served the city for 30 years in many engineering capacities, including management of the municipal waterworks. He was in part responsible for the success of this municipal venture, which shines by comparison. It belies everything said against public ownership of utilities. Its service has never been excelled. Politics has never stained its good name. Both Republican and Democratic mayors have retained Mr. Wall, an outstanding demonstration of the ideals behind civil service. Now, Mr. Wall, after being out of public service 7 years, is restored to it. The appointment is an expression of confidence."

Excavation for Swimming Pool at White House Completed

Excavating and underpinning required for installation of the swimming exercise tank in the White House, which commenced April 1, have now been completed by the Office of Public Buildings and Public Parks. In the meantime the detailed designs and specifications were prepared and bids invited from five local firms qualified to do the work, the expense of which has been defrayed by popular subscription of funds, formally accepted by resolution of Congress, March 30.

The tank will be located indoors within the west terrace in rooms previously occupied by a part of the White House secretarial staff. This location was selected as the one most convenient for an indoor pool for use throughout the year, and in addition it involved no change in the architectural appearance of either the building or the grounds. It was found that by removing old partitions there was just sufficient space to install a small but adequate tank with the necessary dressing and machinery rooms.

The bottom of the old footings are at a depth of about 2 ft., and it was therefore found necessary to underpin the side walls to a depth of from 6 to 10 ft.

The tank will have a capacity of 35,000 gal. and will be approximately 15x50 ft. in size, with a 4-ft. walkway on the long side and, at the east end, a 7-ft platform and two small dressing rooms, equipped with showers. The tank will have the usual complement of diving boards, ladders and other fixtures.

The machinery room will contain the heater, pumps, filters, and purifying devices. Water will be recirculated through the filters and a constant temperature maintained by thermostatic control. The cost of the project is estimated at $20,000.

Demolition of old partitions and the underpinning of approximately 150 ft. of brick side walls revealed that this wing of the White House, believed to have been built prior to burning by the British in 1814, has served a variety of purposes. At one time or another it has been used as a stable, slave quarters, greenhouse, maid's bedrooms, laundry, and offices. About 300 cu.yd. of earth are involved in the necessary excavation.

Because of the intensive use to which every foot of floor space in the west terrace is put, some rearrangement of offices was necessary.

Bids Submitted on Bridge and Two Viaducts at Richmond

A low bid of $875,000 was received by the Richmond Bridge Corp. for its proposed bridge over the James River at Richmond, Va., when bids were opened on April 12 and 13. The bid was submitted by S. M. Siesel Co. of Milwaukee, Wis. The firm of Seeds & Derhan of Philadelphia, bid $920,000; Hunkin-Conkey Construction Co. of Cleveland, bid $972,000; W. W. Boxley & Co., of Roanoke, Va., bid $1,060,000.

T. A. Loving & Co. of Roseboro, N. C., bid $159,500 for the Fifth St. viaduct and J. S. Bowers, of Whiteville, N. C., bid $150,500 for the First St. viaduct.

At a later date the corporation will receive bids on a small bridge over the Atlantic Coast Line tracks and for reconditioning the Marshall St. viaduct.

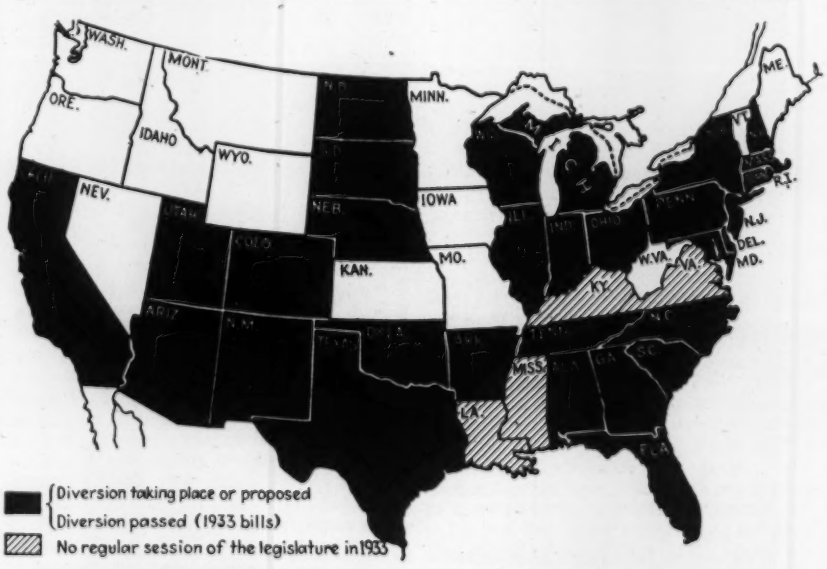
The bids have to be approved by the Reconstruction Finance Corp. before contracts can be awarded.

Chicago Regional Association Active in Plan and Relief Work

Acting as a "trouble shooter" in untangling misunderstandings and controversies between the 15 counties, numerous municipalities, park boards and forest preserves so that planned work could go ahead, has been one of the outstanding services of the Chicago Regional Planning Association for the past year, Robert Kingery, secretary and director, told the 200 members and guests at the annual meeting April 11. Another activity was extensive participation of the director in the preparation of the report of the state commission on future road program. Mr. Kingery also has been appointed acting director of public works of the state, which agency is putting into effect the new program.

Zoning administration in the region has been served continually by the association through the centralization of information as to some 300 decisions of high courts. Monthly, new decisions are briefed and sent out to the various zoning boards. A forward step has been made in DuPage County where the whole rural area is in the process of being zoned, all without a state law of authorization. The association has helped in surveys of present land uses and in framing the ordinances for the county board of supervisors. It is felt that in nine out of ten cases the ordinances will be observed and later a state enabling law will be enacted.

Stream pollution prevention has been fostered through cooperation between county and State Board of Health and a complete survey has been made of all streams. Through the forest preserves cleaning of these streams of debris has been accomplished by thousands of men assigned by official emergency relief organizations



MOTOR-VEHICLE-TAX DIVERSION IN 1933

The most conservative estimates place the direct diversion of motor taxes by states in 1932 at more than $145,000,000. Indirectly—that is to say, where motor tax funds pledged for local road and street work were used as doles, as was the case in Ohio, Massachusetts and other states,—it was a sum infinitely greater and difficult to tabulate. What of 1933? As the accompanying map shows, in 28 out of 48 states there are legislative proposals to divert (or keep on diverting) highway funds to other uses. In New York, it is proposed to divert almost 80 per cent of highway revenue. In South Dakota, the current legislature has already passed a law giving one-half of the gas tax to counties for rural credits; while Rhode Island has legalized a $3,000,000 bond issue to be amortized in five years from gas tax funds.

to work for their contributions received.

Within a month it is expected that from 1,000 to 2,000 $30 a month men recruited under the recently enacted reforestation law will be at work in the Skokie marsh making lagoons and filling and reforesting adjoining lands, according to M. H. Bickham, director of the work relief committee of Cook County Illinois Emergency Relief Commission, who spoke before the meeting on "Earned Relief Programs."

Of all applicants passing Dr. Bickham's office three years ago 99 per cent were willing to work. The figure now is 95 per cent. This indicates the drop in morale. From 800,000 to 850,000 in Cook County are on relief. In 2½ years $6,000,000 has been spent on earned relief and 126,000 work orders have been given out.

The planning organization reelected Daniel H. Burnham, president, Robert Kingery, secretary and Joseph K. Brittain, treasurer. Average annual expenditures for the last eight years have been $42,000. This past year the expense has been $23,670, a reduction of 43 per cent over the previous year with a $1,311 deficit of a year ago cut to $254 this year. Although with greatly reduced expenditures the major portion of the staff has been maintained and the association will continue to function largely as in the past.

Texas Dam Projects Aided

A bill which has passed both houses of the Texas legislature authorizes seven water improvement districts in Ward, Pecos, Reeves, Loving and Crane counties in Texas to combine for the purpose of borrowing money from the Reconstruction Finance Corp. for the construction of a dam on the Pecos River near the New Mexico line.

Suit Begun to Test Legality of San Francisco Bridge Bonds

A friendly suit to test the legality of the legislation authorizing the Toll Bridge Authority of the state of California to issue bonds for the construction of the San Francisco-Oakland Bay bridge has been begun in the supreme court of the state. The legality of the bond issue must be established before the Reconstruction Finance Corp. will take the Bridge Authority bonds as security for its proposed loan for the construction of the bridge.

Contracts Let Quickly for Work on State Parks on Long Island

Three weeks after the Reconstruction Finance Corp. had authorized the loan of $5,000,000 to the Jones Beach State Parkway Authority, the first contracts for work on the project were let on April 13. The principal contract let was for the dredging of 10,100,000 cu. yd. of sand out of Great South Bay to form embankments for approaches to Jones Beach. This contract was let to the Atlantic Gulf & Pacific Co. for $796,890. A contract also was let by the Parkway Authority to Johnson, Drake & Piper, Freeport, L. I., for $242,932 for the reconstruction of Wantagh parkway and for the enlargement of the parking field at Jones Beach.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Chicago, June 27-30.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chicago, June 26-30.

AMERICAN WATER WORKS ASSOCIATION, anual meeting, Chicago, June 12-16.

AMERICAN WELDING SOCIETY, annual meeting, New York, N. Y., April 27-28.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual convention, Chicago, June 26-28, 1933.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Chicago, June 27-30.

ENGINEERS WEEK, Century of Progress Exposition, Chicago, June 25-30.

THE MARYLAND-DELAWARE WATER AND SEWERAGE ASSOCIATION will hold its seventh annual conference in Baltimore, Md., May 4-5.

THE RAILWAY TIE ASSOCIATION will hold its 15th annual convention at Richmond, Va., May 10-11.

THE SOUTHEASTERN SECTION, American Water Works Association, at its convention held recently in Albany, Ga., elected J. K. Marquis of Spartansburg, S. C. as president, and R. E. Findley of Macon, Ga., vice-president, and W. H. Weir, Atlanta, secretary-treasurer.

THE CHAMBER OF COMMERCE OF THE UNITED STATES will hold its annual meeting in Washington, D. C., May 2-5. Construction men have been asked to participate in a round table discussion on property maintenance and improvement held during the afternoon of Wednesday, May 3.

Brief News

CONSTRUCTION OF A 16,300-ACRE LAKE near Ardmore, Okla. at a cost of $90,000 is authorized by a bill passed recently by the Senate of Oklahoma. If approved in the lower house, it is expected that application will be made to the R.F.C. for a loan to finance construction.

THE HIGHWAY LAW OF NEW YORK STATE has been amended to authorize the superintendent of public works to return to successful contractors their certified checks amounting to at least 5 per cent of the estimated cost of work, which the law requires shall be submitted with the bid, when 10 per cent of the work under the contract has been completed.

DAMAGES OF $158,000 have been awarded to the Red River Bridge Co. by a federal court jury sitting at Muskogee, Okla., in its suit against the state of Oklahoma for alleged damages sustained when the state built a free bridge across the Red River parallel to the company's toll bridge between Denison, Texas, and Durand, Okla. The bridge has been a source of trouble and conflict over a long period of time.

PLANS FOR A BRIDGE across the York River immediately upstream from Yorktown and Gloucester Point, Va., prepared by the Independence Bridge Co., Richmond, Va., have been approved by the War Department. The War Department's approval is limited to the life of the state highway commission's approval which requires the bridge company to secure funds for the proposed bridge by June 1, 1933, to commence construction by September, 1933, and to have the bridge completed within 18 months thereafter. The proposed bridge is estimated to cost $1,200,000 and is one of several proposed to be financed by loans from the Reconstruction Finance Corp.

Personal Notes

T. H. BALDWIN, city engineer of Cheyenne, Wyo., has resigned as state water commissioner for District No. 1, the district embracing the Cheyenne area.

OLIVER DOWNS has been appointed district engineer at Crawfordsville, Ind., to succeed C. C. Newson, and R. H. Bower has been appointed district engineer at Fort Wayne to succeed F. R. McNiece.

MILO P. FOX, major, Corps of Engineers, district engineer at Galveston, Texas, is to be relieved from that assignment about July 1 and transferred to Washington to become resident member of the Board of Engineers for Rivers and Harbors.

FRANCIS H. WISEWELL has opened an office in Rochester, N. Y. as consulting engineer specializing in the design, construction and operation of power and industrial plants, the design of steel structures and in valuation.

FRANK S. BESSON, major, Corps of Engineers, U. S. Army, district engineer at Nashville, Tenn., is to be relieved from that assignment about Aug. 1 and transferred to the office of the Chief of Engineers, Washington, D. C.

BAXTER L. BROWN, consulting engineer, St. Louis, has been appointed president of the Board of Public Service of that city by the newly-elected mayor. As noted elsewhere in this issue, Edward E. Wall, former director of public utilities, has been reappointed to that position.

H. S. CROCKER, consulting engineer, Denver, has been named a member of the Denver Board of Water Commissioners to succeed W. H. Leonard, president of the Gardner-Denver Co., who resigned on account of the pressure of business. HERBERT S. SANDS, consulting engineer, Denver, also has been appointed a member of the board. He fills the vacancy caused by the death of C. M. Einfeldt.

O. R. DINSMORE, district engineer, Olympia and Olympia Peninsular District, Washington State Highway Department, has been transferred to the position of engineer in charge of the district's headquarters at Vancouver, Washington, to succeed Walter A. Schwarz. JAMES A. DAVIS, of Olympia, has been appointed district engineer to succeed Mr. Dinsmore. O. R. ELWELL, assistant bridge engineer, of the state highway department, has been appointed bridge engineer.

JAMES A. WOODRUFF, colonel, Corps of Engineers, U. S. Army, has been named to the post of director of the Office of Public Buildings and Public Parks, Washington, D. C. to succeed Lieut. Col. U. S. GRANT, 3d, when Colonel Grant enters the 1933-34 course at the Army War College. The assignment of Colonel Grant to the Army War College ends nearly seven years of duty as director of Public Buildings and Public Parks in Washington, he having been kept there over the normal four-year period because of his duties with the Arlington Memorial Bridge Commission and the George Washington Bi-centennial Commission. Colonel Woodruff has been on duty at the Command and General Staff School at Fort Leavenworth.

Obituary

JAMES R. MCCLINTOCK, a member of the firm of Fuller & McClintock, consulting engineers, New York, died at his home there on April 11 following an illness of several weeks. Mr. McClintock was born in Malden, Mass. in 1883 and was educated at the University of Rochester and the Massachusetts Institute of Technology, from which he graduated in 1906. His entire professional career was spent with the firm of Hering & Fuller, the firms of George W. Fuller, and since 1916, Fuller & McClintock. In his earlier practice Mr. McClintock was resident engineer on several pumping stations and filtration plants. Subsequently he had devoted his attention to the design of water supply, water purification and sewage disposal systems. Most recently he was in charge of the design of the Ward's Island sewage treatment plant at New York. Prior to that he was in charge of the Toledo office of the firm and most of the time from 1921 to 1925 was spent in Kansas City in charge of the design of the new water supply work there.

JOHN M. MERCER, prominent construction engineer in Canada and vice-president of the Northern Construction Co., died at his home in Vancouver, B. C., April 12, age 56 years.

J. W. LINK, for many years chief hydraulic engineer of the Byllesby Engineering & Management Corp., Chicago, died at his home in Evanston on April 14 following a long illness. Mr. Link was a native of Richmond, Va., and studied engineering at the Virginia Mechanics Institute Night School of Technology. After some years of service with the Metropolitan Water Board of Boston he became a designer for the Canadian Niagara Power Co. Subsequently he was on hydro-electric work on the St. Lawrence river and on the New York State barge canal. He joined the firm of H. M. Byllesby & Co. in 1910.

WILLIAM E. METZGER, director, American Automobile Association, and chairman of the executive committee of the National Conference on Street and Highway Safety, died in Detroit, April 11. He was a pioneer in the automobile industry and a leader in the movement sponsored by Herbert Hoover when Secretary of Commerce looking toward relief of traffic congestion and adoption of uniform traffic regulations.

ROBERT C. STRACHAN, consulting engineer, New York, died suddenly at his home in Brooklyn on April 16, age 71 years. Mr. Strachan was a graduate civil engineer of New York University in the class of 1883 and spent most of his professional career on bridge work in and around New York City, including a large part of the original studies for the Queensboro bridge. In 1928 he entered into consulting practice.

Engineering Contracts and Capital

WITH public-works construction practically at a standstill pending formation of a national program, heavy engineering construction contracts for the past week dropped to a new low of $7,636,000. Contracts totaled $13,046,000 the previous week, and the average of the past four weeks is $12,919,000. A year ago contracts were averaging $25,568,000 weekly. Public works awards for the past week amounted to $4,544,000, of which nearly one-fourth consisted of contracts for approaches to Jones Beach on Long Island, New York. Federal awards were only $502,000, a long-time low reflecting the results of the Administration's edict that no new contracts would be awarded until a definite construction program is decided upon. Private contracts remained low as usual, amounting to $3,092,000, the average of the past two months. In the private field industrial buildings made an unusual showing with contracts totaling $2,405,000, the largest weekly amount for this class of work in two months. The Jones Beach highway contracts amounting to $1,040,000, was the only large award reported during the week.

Several large projects were announced during the week as being in the planning stage. Largest of these is a 9-million dollar oil refinery at Houston. Lakewood, Ohio, announced plans for a water filtration plant to cost $1,000,000. A grade elimination at Rochester, N. Y., involving the N.Y.C.R.R. and the B.&O.R.R. is planned, estimated at $1,000,000. Plans were announced for a brewery in Washington, D. C., to cost 2½ millions. A low bid of $1,208,000 was received for the new University Hospital at Baltimore.

New productive capital issues sold during the week, all public issues, amounted to $1,334,000, bringing the total to date this year to $72,201,000. Last year at this time cumulative capital issues amounted to $272,000,000. No new loan approvals for self-liquidating works were announced by the Reconstruction Finance Corp., nor did the corporation make any advances on previous commitments.

Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Apr., 1932	Average Four Weeks	Week Apr. 20, 1933
Federal government	$2,912	$2,350	$ 502
State and municipal	14,799	5,186	4,042
Total public	$17,686	$7,536	$4,544
Total private	7,882	4,947	3,092
Week's total	$25,586	$12,483	$7,636
Cumulative to date			
1932		$346,216	
1933		251,777	

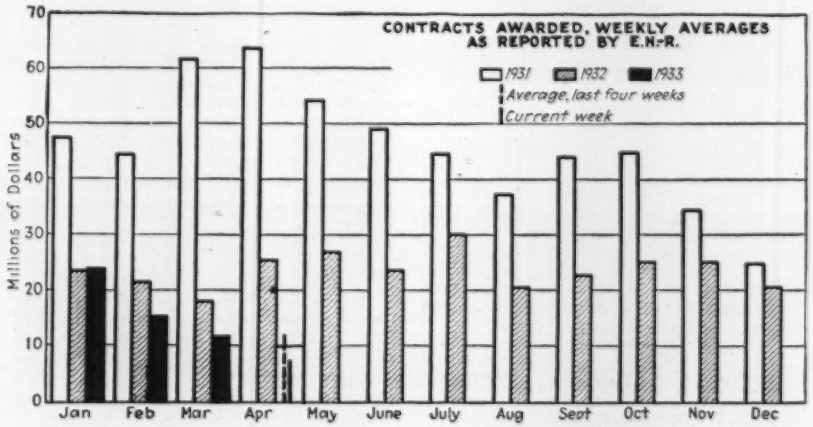
NEW PRODUCTIVE CAPITAL

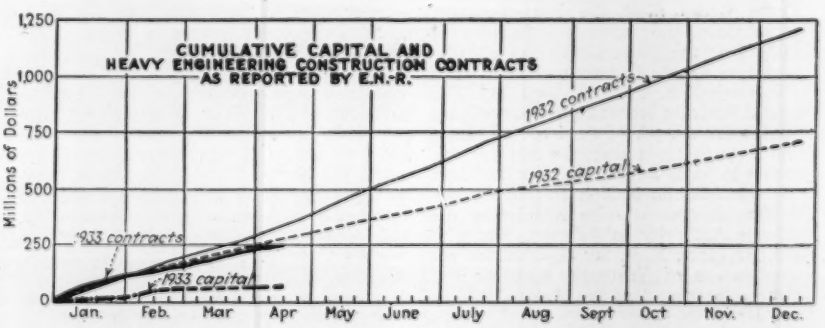
(Thousands of Dollars)

	Weekly Apr., 1932	Average Four Weeks	Week, Apr. 15, 1933
New capital issues	$11,500	$1,051	$1,334
Cumulative to date:			
1932		$295,000	
1933		72,201	
R.F.C. self-liquidating loans:			
Approved current week			
Approved to date (including 1932)			$202,171
Actual loans made (including 1932)			20,461

ENR Cost and Volume Index

E.N.-R. Cost		E.N.-R. Volume	
April, 1933	**160.16**	**March, 1933**	62
March, 1933	158.44	February, 1933	82
April, 1932	153.12	March, 1932	97
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average	100		

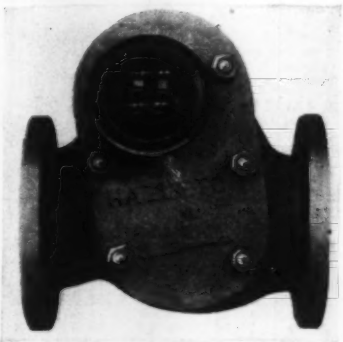




Construction Equipment and Materials

Check Valve Stops Pump When Flow Ceases

A check valve equipped with a mercoid flow switch has been introduced by Barrett, Haentjens & Co., Hazleton, Pa. The switch is connected in the low-voltage coil of the motor starter and is actuated by the valve flap. When the pump is in operation and delivering water, the flow through the



Mercury switch mounted on flap of check valve.

valve raises the flap and closes the switch. When the pump loses its water the flap falls, the switch opens, and stops the pump.

The switch can be arranged for either horizontal or vertical valve mounting.

New Dry Feeder for Chemicals

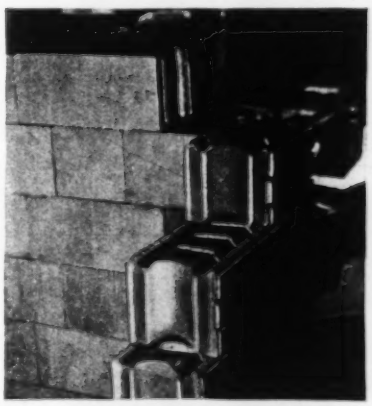
The International Filter Co., Chicago, Ill., announces its No. 8 dry chemical feeder. The feed does not depend upon the flow of material through an opening or orifice. An adjustable knife, fitted in a stationary ring, cuts off a section of a revolving cylinder of powdered or granular material contained in a revolving drum and supported on a revolving table. The depth of cut is controlled by a worm gear adjustment and the position of the feed knife is shown by a large dial and pointer. Further adjustments of the feed are possible by using a feed knife of different thickness or by changing the speed of the drum and table.

The dry feeder is designed for constant rate operation the rate of feed being manually controlled. The feed range for various chemicals is as follows: powdered carbon, minimum 1 ounce, maximum 50 lb. per hour; hydrated lime, minimum 2 ounces, maximum 100 lb. per hour; alum, minimum 8 ounces, maximum 150 lb. per hour.

International Filter Co.'s new dry-feed machine

Genuine Facade Used With Concrete Building Block

The National Facade Corp., Pittsburgh, Pa., announces a new type of concrete building block in the face of which is embedded brick, sandstone or any other desired type of genuine facade. Horizontal grooves on top of the blocks take the mortar. The blocks are of tongue and groove construction and the company states that the irregularities in the blocks are completely hidden when they fit together.



Brick, sandstone or other genuine facade is embedded in the face of concrete block

The company states that it is possible to manufacture these units on standard concrete block machines of the poured or tamped type now in existence with only minor changes in equipment.

Business Notes

SPROUT, WALDRON & CO., INC., Muncy, Pa., announces that on April 5 the New York office of the company was closed and the business of the company was transferred to the office at Westfield, N. J.

RAYMOND F. GARCIA has been appointed general manager of sales of the Universal Pipe Division of the Central Foundry Company, 420 Lexington Ave., New York, N. Y. Mr. Garcia succeeds Leonard W. Saine, who has resigned.

INDEPENDENT PNEUMATIC TOOL CO., Chicago, Ill., announces that Neil C. Hurley has been elected president to succeed Ralph S. Cooper who has been named vice-president in charge of western operations of the firm with headquarters in New York.

New Equipment in Brief

Sewage Pumps. A new, non-clogging pump for raw sewage is announced by Buffalo Pumps, Inc., Buffalo, N. Y. The impeller is mounted on ball bearings. The manufacturer states that there are no projecting surfaces and nothing to obstruct the flow of solids or foreign material. Bearings are designed to be kept free from moisture, dust and other foreign material.

Road Grader. The Austin-Western Road Machinery Co., Chicago, Ill., has introduced its new Austin No. 12 grader. It has a heavy 12 ft. blade, with railroad rail reinforcement, cuts 18 in. below ground level and has a high reach of 7 ft. 10 in. Hydraulic power control is provided for leaning wheels, shifting rear axle and operating blade, pole steer and scarifier.

Manhole Cover. Semi-Steel Casting Co., 109 East Quincy St., St. Louis, Mo., has announced a lock-type manhole cover made of semi-steel. The manufacturer states that the cover can be locked and unlocked with a pick or bar and can be placed into frames that are already installed in the street. The cover is held tightly in the frame by two lock-type castings or dogs.

Compressor. A new portable sleeve-valve air compressor has been announced by the Mercer Engineering Works, Inc., Elizabethport, N. J. The manufacturer states that air passages are clear and unobstructed, and that use of the sleeve valve makes possible a large area of inlet openings to the cylinder. The compressor design also makes possible the entry of air into the cylinder without becoming heated before compression.

Floor Grinder. The new Mall high speed floor and border grinding machine is announced by the Mall Tool Co., 7740 S. Chicago Ave., Chicago, Ill. The machine uses a high speed bakelite abrasive wheel revolving at a speed equivalent to 9,000 surfacing feet per minute. Water is fed through the center of the spindle and is carried by centrifugal force between the wheel surface and the floor. It is mounted on low-friction bearing casters and wheels.

New Publications

Power Shovel. The Keystone Driller Co., Beaver Falls, Pa., has published a 42 page illustrated booklet describing the Keystone Model 18, a 1-yd. shovel, crane, skimmer and pullscoop. The various parts of the machine are described in detail, both by text and by illustrations, and the various uses to which the machine can be put are discussed.

Curing Concrete. "Curing Modern Concrete Roads" is the title of a 20-page bulletin recently issued by the Philadelphia Quartz Co., Philadelphia, Pa. It covers the developments in curing concrete with silicate of soda, from the road laid in Dallas County, Texas, in 1918 to present day construction in all parts of the country. The booklet also gives the cost of silicate curing and instructions for application.

Activated Carbon. The Industrial Chemical Sales Co., Inc., 230 Park Ave., New York, N. Y., has just published a booklet of 44 pages entitled "Activated Carbon—The Modern Purifier." The booklet describes the origin and characteristics of activated carbon as a purifying medium and then proceeds to describe the uses to which it is put in various industries. The applications listed, in which carbon is used as a purifying agent, include sugar and syrup, vegetable and animal oils and fats, the purification of dry cleaner solvent, water for taste and odor removal, and to chemical, pharmaceutical and other products. The section on the application of carbon to water purification consists of five pages.

Current Construction Unit Prices

Contracts 3 and 5, San Francisco Bay Bridge

BIDS WERE OPENED March 28 and 29 for Contracts 3 and 5, San Francisco-Oakland bridge across San Francisco Bay. Contract 3 is for the San Francisco anchorage of the west bay suspension spans, and the San Francisco approach to Rincon Hill. Contract 5 is for the Yerba Buena Island crossing, consisting of a double-deck tunnel 500 ft. long, and a viaduct leading to the east bay crossing. Contract 5 also includes the east anchorage for the west bay suspension bridge. Unit prices of the other four main contracts, 2, 4, 6, and 7, for the superstructure and substructure of the east bay and west bay crossings, were published in *ENR*, March 23, 1933, p. 393. Prevailing wages established for the construction of the bridge were also published at that time. None of the contracts has as yet been officially awarded. The bridge project is being built by The California Toll Bridge Authority, a state agency, with funds pledged by the Reconstruction Finance Corp. Unit prices for Contracts 3 and 5 follow:

Contract 3—S.F. anchorage and approach

LIST OF BIDDERS AND TOTAL BIDS

Bidders	Total bids
A—Healy-Tibbitts Const. Co., San Francisco	$1,036,500
B—Clinton Const. Co., San Francisco	1,048,675
C—Winston Bros. Co., Minneapolis, and L. E. Dixon Co., Los Ang.	1,136,878
D—MacDonald & Kahn, Ltd., San Francisco	1,139,998
E—Geo. Pollock Co., San Francisco	1,146,730
F—Youdall Const. Co., Stroud Bros., and Seabrook & C. M. Elliott, San Francisco	1,224,950
G—Mercer-Fraser Co. and Geo. R. Cooke Co., Eureka	1,281,835
H—Silas Mason Co., New York and San Francisco	1,296,650
I—Bridge Builders, Inc., San Francisco	1,297,950
J—Walsh Construction Co., Los Angeles	1,396,400

Item	Quan.	Description
1.	50,000 cu. yd.	Unclassified excavation
1.	2,700,000 lb.	Structural steel in anchorage
3.	12,000 cu. yd.	Concrete in anchorage, erection block
4.	53,000 cu. yd.	Concrete in anchorage
5.	3,000 cu. yd.	Concrete in anchorage above lower deck
6.	300 cu. yd.	Concrete in viaduct footings
7.	5,800 cu. yd.	Concrete in viaduct above footings
8.	200 cu. yd.	Concrete railings
9.	10,000 cu. yd.	Concrete, fdns., Piers A, B and I.
10.	9,500 cu. yd.	Concrete above fdns., Piers A, B and I
11.	2,800,000 lb.	Reinforcing steel
12.	25,000 lb.	Miscellaneous metal work
13.	lump sum	Electric conduits and fittings
14.	20,000 lb.	Cast iron drain pipe and fittings
15.	10,000 lb.	Castings
16.	2,000 bbl.	Extra cement
17.	Lump sum	Demolish buildings

Item	Complete Unit Prices									
	A	B	C	D	E	F	G	H	I	J
1...	$2.00	$3.00	$2.61	$3.52	$2.81	$3.05	$6.05	$5.00	$3.00	$3.00
2...	.05	.06	.064	.0625	.063	.068	.041	.06	.06	.07
3...	8.80	5.70	6.38	6.00	7.83	8.40	7.20	7.00	7.00	6.00
4...	6.00	6.50	7.00	6.75	6.00	7.00	7.05	7150	10.00	11.00
5...	6.00	9.60	13.28	12.10	8.00	8.80	13.00	12.50	14.00	16.50
6...	15.00	7.20	9.52	6.70	9.00	12.00	8.50	9.00	8.00	11.00
7...	9.00	13.00	16.92	15.85	14.00	15.00	19.40	15.00	16.00	23.00
8...	30.00	32.00	39.50	25.00	40.00	15.00	30.00	30.00	40.00	30.00
9...	5.00	5.75	6.74	6.27	8.00	8.40	7.35	8.00	8.00	6.00
10...	11.00	7.30	8.28	9.00	11.20	9.00	9.30	10.00	11.00	11.00
11...	.025	.03	.032	.0282	.025	.031	.025	.03	.03	.035
12...	.04	.16	.08	.16	.10	.16	.13	.15	.07	.12
13...	1,000	840	1,100	1,115	600	750	1,200	1,000	1,100	2,300
14...	.05	.04	.06	.084	.05	.07	.06	.10	.04	.06
15...	.05	.09	.09	.082	.24	.14	.10	.15	.12	.06
16...	1.75	2.00	1.80	1.90	1.50	1.90	1.50	2.00	2.00	2.00
17...	1,000.	2,300.	2,200.	1,100.	2,000.	2,800.	1,000.	5,000.	1,200.	2,000

Contract 5—Yerba Buena crossing

LIST OF BIDDERS AND TOTAL BIDS

Bidders	Total bids
A—Clinton Const. Co., San Francisco	$1,821,293
B—Connolly-Hanrahan & Geo. Pollock, San Francisco	1,871,670
C—Bridge Builders, Inc., San Francisco	1,874,000
D—Silas Mason Co., New York and San Francisco	1,993,050
E—Youdall Const. Co., C. M. Elliott, Stroud Bros. & Seabrook, San Francisco	1,967,833
F—Lindgren-Swinerton & Associates, San Francisco	2,150,850
G—Winston Bros. Co., Minneapolis, & L. E. Dixon, Los Angeles	2,249,958

QUANTITIES AND DESCRIPTION

Item	Quan.	Description
1.	330,000 cu. yd.	Unclassified excavation
2.	Lump sum	Anchorage tunnels
3.	3,000,000 lb.	Structural steel in anchorage
4.	2,750 cu. yd.	Concrete in anchorage fdns.
5.	8,350 cu. yd.	Concrete in anchorage above fdns.
6.	3,000 cu. yd.	Concrete in footings, viaduct and wall
7.	10,000 cu. yd.	Concrete in viaduct and wall above fdns.
8.	300 cu. yd.	Concrete railings
9.	Lump sum	Highway tunnel
10.	3,500 cu. yd.	Concrete in fdns. Piers YB-2 to YB-4 and E-1
11.	8,500 cu. yd.	Concrete above fdns., same piers
12.	250 cu. yd.	Concrete in curbs and gutters
13.	850 cu. yd.	Stone base, crusher run
14.	650 cu. yd.	Crushed stone roadway surfacing
15.	50 bbl.	Fuel oil
16.	50 tons	Cut-back asphalt
17.	4,400,000 lb.	Reinforcing steel
18.	10,000 lb.	Miscellaneous metal work
19.	Lump sum	Electrical conduit and fittings
20.	1,500 cu. yd.	Concrete paving, lower deck
21.	51,000 lb.	Cast iron drain pipe and fittings
22.	13,000 lb.	Castings
23.	Lump sum	Drain tile, 4 to 12 in.
24.	2,300 bbl.	Cement, tunnel roof grouting
25.	23,000 lin. ft.	Pipe piles
26.	200 lin. ft.	Jet drilling
27.	100 lin. ft.	Diamond drilling
28.	2,000 bbl.	Extra cement

Item	Complete Unit Prices						
	A	B	C	D	E	F	G
1.....	$0.685	$1.10	$0.50	$1.00	$0.82	$1.40	$0.835
2.....	133,000	135,080	170,000	170,000	106,000	150,000	123,350
3.....	.067	.06	.07	.06	.07	.06	.078
4.....	6.65	12.00	7.50	8.00	7.80	12.00	7.15
5.....	9.50	10.00	11.00	12.00	10.90	12.00	12.95
6.....	7.70	15.00	8.00	10.00	10.00	12.00	10.60
7.....	13.20	13.00	16.00	12.50	16.00	19.00	20.30
8.....	27.00	40.00	40.00	30.00	40.00	33.00	40.91
9.....	610,000	530,000	624,275	590,000	666,340	560,000	769,050
10.....	7.75	12.00	8.00	8.00	10.00	10.00	7.35
11.....	8.65	8.00	10.00	10.00	11.00	11.00	10.07
12.....	22.60	12.00	12.00	20.00	18.90	9.00	20.00
13	3.50	4.00	3.00	5.00	2.80	2.00	4.52
14.....	4.30	4.00	3.00	5.00	3.10	2.00	4.60
15.....	3.50	5.00	3.00	5.00	2.40	2.00	2.52
16.....	23.00	30.00	20.00	40.00	19.20	22.00	35.00
17.....	.031	.025	.03	.03	.031	.03	.037
18.....	.18	.15	.07	.25	.16	.15	.13
19.....	7,500	6,000	8,000	12,000	6,900	10,000	10,120
20.....	11.20	10.00	10.00	10.00	8.00	9.00	9.24
21.....	.04	.06	.04	10	.06	.10	.06
22.....	.07	.08	.12	.20	.12	.10	.084
23.....	1,950	2,000	3,000	1,500	2,653	1,000	1,460
24.....	9.25	2.00	6.00	6.00	3.50	3.00	17.00
25.....	3.50	4.00	4.00	5.00	3.50	5.00	4.60
26.....	16.00	1.00	5.00	3.00	15.00	15.00	10.00
27.....	4.60	15.00	15.00	50.00	20.00	18.00	20.00
28.....	2.10	1.22	2.00	2.00	2.00	2.00	2.07

Shushan Airport Drainage, New Orleans

CONTRACT WAS AWARDED on March 24 for the installation of a drainage system at Shushan Airport, New Orleans, involving 12,624 cu. yd. of trench excavation, 16,265 ft. of concrete pipe and 10,065 cu yd. of backfill, and some 60 manholes. The work is being done by the Board of Levee Commissioners, Orleans Parish, John Klorer, chief engineer. Seven bids were submitted ranging from $65,811 to $92,300. Following are unit prices of the three low bidders. *A*—A. P. Boh & Co., New Orleans, contract $65,811; *B*—Mike Mitchell & Son, New Orleans, $69,000; *C*—Sciambra & Masino, Inc., New Orleans, $73,000.

Item	Quantity	Unit Prices A	B	C
Trench excavation	12,624 cu.yd	$0.45	$0.18	$0.305
Concrete pipe 10 in.	3,240 l.f.	1.00	1.03	1.28
Concrete pipe 12 in.	2,200 l.f.	1.00	1.12	1.40
Concrete pipe 15 in.	4,340 l.f.	1.25	1.38	1.60
Concrete pipe 18 in.	3,210 l.f.	1.50	1.52	1.88
Concrete pipe 21 in.	940 l.f.	2 34	1.80	2.24
Concrete pipe 24 in.	520 l.f.	2.00	2.10	2.61
Concrete pipe 30 in.	330 l.f.	2.50	2.32	2.94
Concrete pipe 36 in.	280 l.f.	3.00	3.85	4.46
Conc. pipe oval 36x40 in.	580 l.f.	4.00	6.52	6.73
Conc. pipe oval 42x46 in.	625 l.f.	4.00	7.14	7.50
Subgrade flooring	171 Mft.bm.	20.00	19.50	22.89
Timber sheeting and bracing	72.6 Mft. bm.	28.00	44.40	31.99
Backfill, earth or sand	4,021 cu.yd.	.70	.63	.57
Backfill, clamshell	4,744 cu.yd.	2.70	3.00	2.46
Backfill, pitch covered slag	1,300 cu.yd.	5.50	6.42	6.19
Manholes, 6x6x8 ft.	5	300.00	144.44	182.70
Manholes, circular 5 to 9 ft. in height	500 vert.ft.	10.00	10.00	10.09